

```

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  <title>Technical Q&A QA1160: Preventing sleep</title>
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  <meta charset="utf-8">
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content="Technical Q&A">
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content="//apple_ref/doc/uid/DTS10003426">
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  <meta id="date" name="date" content="2018-06-04">
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your application can prevent the system from sleeping.">
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  <meta id="book-json" name="book-json" content="book.json">
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  <meta id="devcenter-url" name="devcenter-url"
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  <meta id="book-assignments" name="book-assignments"
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All Rights Reserved.">
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QA1160">
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href="../../Resources/1282/CSS/screen.css">

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href="../../Resources/1282/CSS/feedback.css">
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title="Technical Q&A QA1160"></a>
  <div id="_omniture_top">
  <!-- SiteCatalyst code version: H.8. Copyright 1997-2006 Omniture, Inc. -->
  <script type="text/javascript">
/* RSID: */

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var s_account="appleglobal,appleusdeveloper,dappdeveloperlib"
</script>

<script type="text/javascript"
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<script type="text/javascript">
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/***** DO NOT ALTER ANYTHING BELOW THIS LINE ! *****/
var s_code=s.t();if(s_code)document.write(s_code)</script>
<!-- End SiteCatalyst code version: H.8. -->
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Archive</a>
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title="Download PDF" class=""><span id="pdf_icon"></span>PDF</a>
      <a id="Companion_link" role="button" tabindex="3" title="Download
Companion File" class=""><span id="companion_icon"></span>Companion
File</a>
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role="checkbox" aria-label="Show Table of Contents"><span
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    </li>

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Code</button></a>
        </li>
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    <ul id="toc" role="tree"></ul>
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qa1160/index.html_1&quot;;return this.s_oc?this.s_oc(e):true"></a>
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align="center" id="watermark"><div class="legacybox">
<h1>Retired Document<span id="LegacyNoticeCloseBox"
class="closebutton"></span></h1><p><b>Important:</b>
Retired Document: This document may not represent best practices for current
development. Links to downloads and other resources may no longer be
valid.</p></div></div></div>
        <a name="//apple_ref/doc/uid/DTS10003426-CH1-SW1" title="Technical
Q&A QA1160"></a><div class="dtsDocNumber">Technical Q&A
QA1160</div><h1 id="pageTitle">Preventing sleep</h1><div
class="notebox"><aside><a name="//apple_ref/doc/uid/DTS10003426-CH1-
SW2" title="Note"></a><p><strong>Note:</strong>&nbsp;<strong>Removed
Document</strong></p><p>This document has been removed from the ADC
Reference Library. It contained information that had been obsoleted by more
recent documents, or which was longer relevant for modern iOS or Mac OS X
development.</p><p>Current information on this Reference Library topic can
be found here:</p><p><span class="content_text"><a
href="http://developer.apple.com/referencelibrary/index.html"
class="browserLink"
onclick="s_objectID=&quot;http://developer.apple.com/referencelibrary/
index.html_1&quot;;return this.s_oc?this.s_oc(e):true">Reference
Library</a></span></p><p></p></aside></div><h2>Q:&nbsp;  
How can I prevent system sleep while my application is running?
</h2><p><span>A: </span>Most applications should not prevent system
sleep, however, there are exceptions. For example, if your application is playing
a long movie or slideshow, the user will probably get annoyed if the computer
keeps going to sleep. Your application can prevent system sleep by calling
<code>UpdateSystemActivity</code> once every 30 seconds. The following
code shows how to create a <code>CFRunLoopTimer</code> that calls
<code>UpdateSystemActivity</code> every 30 seconds.</p><div
class="importantbox clear"><aside><a
name="//apple_ref/doc/uid/DTS10003426-CH1-DontLinkElementID_1"

```

title="Important:"><p>Important: Retired Document: This document may not represent best practices for current development. Links to downloads and other resources may no longer be valid.</p><p></p></aside></div><p class="codesample clear"><strong class="caption_number">Listing 1 Example usage of
<code>UpdateSystemActivity</code>.</p><div class="codesample clear"><table><tbody><tr><td scope="row"><pre>#include
<CoreServices/CoreServices.h></pre></td></tr><tr><td scope="row"><pre> </pre></td></tr><tr><td scope="row"><pre>void</pre></td></tr><tr><td scope="row"><pre>MyTimerCallback(CFRunLoopTimerRef timer, void *info)</pre></td></tr><tr><td scope="row"><pre>{</pre></td></tr><tr><td scope="row"><pre></pre></td></tr><tr><td scope="row"><pre>UpdateSystemActivity(OverallAct);</pre></td></tr><tr><td scope="row"><pre>}</pre></td></tr><tr><td scope="row"><pre> </pre></td></tr><tr><td scope="row"><pre> </pre></td></tr><tr><td scope="row"><pre> </pre></td></tr><tr><td scope="row"><pre>int</pre></td></tr><tr><td scope="row"><pre>main (int argc, const char * argv[])</pre></td></tr><tr><td scope="row"><pre>{</pre></td></tr><tr><td scope="row"><pre> CFRunLoopTimerRef timer;</pre></td></tr><tr><td scope="row"><pre>CFRunLoopTimerContext context = { 0, NULL, NULL, NULL, NULL };</pre></td></tr><tr><td scope="row"><pre></pre></td></tr><tr><td scope="row"><pre> timer = CFRunLoopTimerCreate(NULL, CFAbsoluteTimeGetCurrent(), 30, 0, 0, MyTimerCallback, &context);</pre></td></tr><tr><td scope="row"><pre> if (timer != NULL);</pre></td></tr><tr><td scope="row"><pre>CFRunLoopAddTimer(CFRunLoopGetCurrent(), timer, kCFRunLoopCommonModes);</pre></td></tr><tr><td scope="row"><pre> }</pre></td></tr><tr><td scope="row"><pre> </pre></td></tr><tr><td scope="row"><pre> /* Start the run loop to receive timer callbacks. You don't need to</pre></td></tr><tr><td scope="row"><pre> call this if you already have a Carbon or Cocoa EventLoop running.
*/</pre></td></tr><tr><td scope="row"><pre>CFRunLoopRun();</pre></td></tr><tr><td scope="row"><pre> </pre></td></tr><tr><td scope="row"><pre></pre></td></tr><tr><td scope="row"><pre>CFRunLoopTimerInvalidate(timer);</pre></td></tr><tr><td scope="row"><pre></pre></td></tr><tr><td scope="row"><pre>CFRelease(timer);</pre></td></tr><tr><td scope="row"><pre> </pre></td></tr><tr><td scope="row"><pre> return (0);</pre></td></tr><tr><td scope="row"><pre>}</pre></td></tr></tbody></table></div>
<hr><a name="//apple_ref/doc/uid/DTS10003426-RevisionHistory-SW1" title="Document

Revision History"><h4>Document Revision History</h4>
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<div class="copyright">
<hr><div align="center"><p class="content_text" lang="en" dir="ltr"> Copyright © 2018 Apple Inc. All Rights Reserved. Terms of Use | Privacy Policy | Updated: 2018-06-04</p></div></div>

<!-- /CONTENTS --><div id="pediaWindow"><div id="pediaHeader"></div><div id="pediaBody"></div></div></article>

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content="{Type/Guide}, {Topic/General}">

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All Rights Reserved.">
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    <link id="previous-page" rel="Prev" type="text/html" href="">
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    <!-- xcode_css -->
    <link rel="stylesheet" type="text/css"
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X,iOS,tvOS,watchOS">
</head>
<body class="" id=""><a name="//apple_ref/doc/uid/TP40009248" title="About
Info.plist Keys and Values"></a>
    <div id="_omniture_top">
    <!-- SiteCatalyst code version: H.8. Copyright 1997-2006 Omniture, Inc. -->
    <script type="text/javascript">
/* RSID: */
var s_account="appleglobal,appleusdeveloper,dappdeveloperlib"
</script>

    <script type="text/javascript"
src="https://www.apple.com/metrics/scripts/s_code_h.js"></script>
    <script type="text/javascript">
s.pageName=AC.Tracking.pageName();
s.channel="www.us.developer"

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/****** DO NOT ALTER ANYTHING BELOW THIS LINE ! *****/

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Archive</a>
    <a id="ssi_AppleDeveloperConnection"
href="https://developer.apple.com/"
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Companion File" class=""><span id="companion_icon"></span>Companion
File</a>
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class="disclosure"></span>Table of Contents</button>
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SW1">Introduction</a></span></li><li class="children "
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class="disclosure"></span><span class="sectionName"><a
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SW1">About Information Property List Files</a></span><ul><li class=" " data-
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100806">Creating and Editing an Information Property List
File</a></span></li><li class=" " data-aref="//apple_ref/doc/uid/TP40009254-
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```


[Commonly Localized Keys](/library/archive/documentation/General/Reference/InfoPlistKeyReference/Articles/AboutInformationPropertyListFiles.html#/apple_ref/doc/uid/TP40009254-SW8)

- [Core Foundation Keys](/apple_ref/doc/uid/TP40009249-SW1)
 - [Key Summary](/apple_ref/doc/uid/TP40009249-SW2)
 - [CFAppleHelpAnchor](/apple_ref/doc/uid/TP40009249-107085-TPXREF103)
 - [CFBundleAllowMixedLocalizations](/apple_ref/doc/uid/TP40009249-130418-TPXREF104)
 - [CFBundleDevelopmentRegion](/apple_ref/doc/uid/TP40009249-130430-BAJJHDJH)
 - [CFBundleDisplayName](/apple_ref/doc/uid/TP40009249-110725-TPXREF135)
 - [CFBundleDocumentTypes](/apple_ref/doc/uid/TP40009249-101685-TPXREF107)
 - [Document Roles](/apple_ref/doc/uid/TP40009249-SW6)
 - [Document Icons](/apple_ref/doc/uid/TP40009249-SW9)
 - [Document Types](/apple_ref/doc/uid/TP40009249-SW7)

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To provide a better experience for users, iOS and macOS rely on the presence of special metadata in each app or bundle. This metadata is used in many different ways. Some of it is displayed to the user, some of it is used internally by the system to identify your app and the document types it supports, and some of it is used by the system frameworks to facilitate the launch of apps. The way an app provides its metadata to the system is through the use of a special file called an *information property list file*, or `Info.plist` for short.

A property list is a way to structure arbitrary data that the system can access at runtime. An *information* property list is a specialized type of property list that contains configuration data for a bundle. The keys and values in the file describe the various behaviors and configuration options you want applied to your bundle. An Xcode project template typically specifies an information property list file with an initial set of keys and appropriate default values. You can edit the file to change or add keys and values, as appropriate for your project.

At a Glance

This document describes the keys and corresponding values that you can include in an information property list file. This document also includes an overview of

information property list files to help you understand their importance and to provide tips on how to configure them.

[name="//apple_ref/doc/uid/TP40009248-SW2" title="The Info.plist File Configures Your App"><h3>The Info.plist File Configures Your](#)

[App</h3><p>Every app and plug-in uses an `Info.plist` file to store configuration data in a place where the system can easily access it. macOS and iOS use `Info.plist` files to determine what icon to display for a bundle, what document types an app supports, and many other behaviors that have an impact outside the bundle itself. </p><div](#)

[class="notebox"><aside><p>Relevant chapter: <a href="..Articles/AboutInformationPropertyListFiles.html#//apple_ref/doc/uid/TP40009254-SW1" data-renderer-version="1"](#)

[onclick="s_objectID="https://developer.apple.com/library/archive/documentation/General/Reference/InfoPlistKeyReference_3";return this.s_oc?this.s_oc\(e\):true">About Information Property List](#)

[Files</p><p></p></aside></div></section><section><h3>Core Foundation Keys Describe Common Behavior</h3><p>There are many keys that you always specify, regardless of the type of bundle you are creating. Those keys start with a CF prefix and are known as the Core Foundation keys. Xcode includes the most important keys in your `Info.plist` automatically but there are others you must add manually.</p><div class="notebox"><aside><a](#)

[name="//apple_ref/doc/uid/TP40009248-SW5" title="Relevant chapter"><p>Relevant chapter: <a href="..Articles/CoreFoundationKeys.html#//apple_ref/doc/uid/TP40009249-SW1" data-renderer-version="1"](#)

[onclick="s_objectID="https://developer.apple.com/library/archive/documentation/General/Reference/InfoPlistKeyReference_4";return this.s_oc?this.s_oc\(e\):true">Core Foundation](#)

[Keys</p><p></p></aside></div></section><section><h3>Launch Services Keys Describe Launch-Time Behavior</h3><p>Launch Services provides support for launching apps. To do this, though, it needs to know information about how your app wants to be launched. The Launch Services keys describe the way your app prefers to be launched. </p><div class="notebox"><aside><a](#)

[name="//apple_ref/doc/uid/TP40009248-SW7" title="Relevant chapter"><p>Relevant chapter: <a href="..Articles/LaunchServicesKeys.html#//apple_ref/doc/uid/TP40009250-SW1" data-renderer-version="1"](#)

[onclick="s_objectID="https://developer.apple.com/library/archive/documentation/General/Reference/InfoPlistKeyReference_5";return this.s_oc?this.s_oc\(e\):true">Launch Services](#)

[Keys</p><p></p></aside></div></section><section><h3>Cocoa Keys Describe Behavior for Cocoa and Cocoa Touch Apps</h3><p>The Cocoa and Cocoa Touch frameworks use keys to identify high-level information such as your app's main nib file and principal class. The Cocoa keys describe those and other keys](#)

that affect how the Cocoa and Cocoa Touch frameworks initialize and run your app. </p><div class="notebox"><aside><p>Relevant chapter: <a href="..Articles/CocoaKeys.html#//apple_ref/doc/uid/TP40009251-SW1" data-renderer-version="1"

onclick="s_objectID="https://developer.apple.com/library/archive/documentation/General/Reference/InfoPlistKeyReference_6";return this.s_oc?this.s_oc(e):true">Cocoa

Keys</p><p></p></aside></div></section><section><h3>macOS Keys Describe Behavior for macOS Apps</h3><p>Some macOS frameworks use keys to modify their basic behavior. Developers of Mac apps might include these keys during testing or to modify certain aspects of your app's behavior. </p><div

class="notebox"><aside><p>Relevant chapter: <a href="..Articles/GeneralPurposeKeys.html#//apple_ref/doc/uid/TP40009253-SW1" data-renderer-version="1"

onclick="s_objectID="https://developer.apple.com/library/archive/documentation/General/Reference/InfoPlistKeyReference_7";return this.s_oc?this.s_oc(e):true">macOS

Keys</p><p></p></aside></div></section><section><h3>iOS Keys Describe Behavior for iOS Apps</h3><p>An iOS app communicates a lot of information to the system using <code>Info.plist</code> keys. Xcode supplies a standard <code>Info.plist</code> with the most important keys but most apps need to augment the standard file with additional keys describing everything from the app's initial orientation to whether it supports file sharing. </p><div

class="notebox"><aside><p>Relevant chapter: <a href="..Articles/iPhoneOSKeys.html#//apple_ref/doc/uid/TP40009252-SW1" data-renderer-version="1"

onclick="s_objectID="https://developer.apple.com/library/archive/documentation/General/Reference/InfoPlistKeyReference_8";return this.s_oc?this.s_oc(e):true">iOS

Keys</p><p></p></aside></div></section><section><h3>watchOS Keys Describe Behavior for Watch Apps</h3><p>Use the <code>Info.plist</code> keys associated with the watchOS frameworks to configure your Watch apps and WatchKit extensions.</p><div class="notebox"><aside><p>Relevant chapter: <a href="..Articles/watchOSKeys.html#//apple_ref/doc/uid/TP40016498-SW1" data-renderer-version="1"

onclick="s_objectID="https://developer.apple.com/library/archive/documentation/General/Reference/InfoPlistKeyReference_9";return this.s_oc?this.s_oc(e):true">watchOS

Keys</p><p></p></aside></div></section><section><h3>watchOS Keys Describe Behavior for Watch Apps</h3><p>Use the <code>Info.plist</code> keys associated with the watchOS frameworks to configure your Watch apps and WatchKit extensions.</p><div class="notebox"><aside><p>Relevant chapter: <a href="..Articles/watchOSKeys.html#//apple_ref/doc/uid/TP40016498-SW1" data-renderer-version="1"

onclick="s_objectID="https://developer.apple.com/library/archive/documentation/General/Reference/InfoPlistKeyReference_9";return this.s_oc?this.s_oc(e):true">watchOS

Keys</p><p></p></aside></div></section><section><h3>watchOS Keys Describe Behavior for Watch Apps</h3><p>Use the <code>Info.plist</code> keys associated with the watchOS frameworks to configure your Watch apps and WatchKit extensions.</p><div class="notebox"><aside><a

Keys

App extensions let you make custom behaviors available in other apps and in system facilities such as notification center. Xcode's app extension templates each supply a standard `Info.plist` file with the most important keys, but you can specify additional keys that describe custom behavior for your app extensions.

Relevant chapter:

[App Extension Keys Describe Behavior for iOS and macOS App Extensions](#)

See Also

For an introduction to property lists, including how they are structured and how you use them in general, see [Property List Programming Guide](#).

Some `Info.plist` keys use Uniform Type Identifiers (UTIs) to refer to data of different types. For an introduction to UTIs and how they are specified, see [Uniform Type Identifiers Overview](#).

Kernel extension developers need to use certain `Info.plist` keys in different ways than app developers do, and also need some kernel-extension-specific keys that have no use in app development. If you are developing a kernel extension, refer to the chapter [Info.plist Properties for Kernel Extensions](#) in [Kernel Extension Programming Topics](#).

```

        <a class="nextLink" rel="next"
href="../Articles/AboutInformationPropertyListFiles.html"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
documentation/General/Reference/InfoPlistKeyReference_11&quot;;return
this.s_oc?this.s_oc(e):true">Next</a>
    </div><br>
    <div class="copyright"><br><hr><div align="center"><p
class="content_text" lang="en" dir="ltr"> Copyright © 2018 Apple Inc. All
Rights Reserved. <a
href="http://www.apple.com/legal/internet-services/terms/site.html"
target="_blank"
onclick="s_objectID=&quot;http://www.apple.com/legal/internet-services/terms/
site.html_1&quot;;return this.s_oc?this.s_oc(e):true">Terms of Use</a> | <a
href="http://www.apple.com/privacy/" target="_blank"
onclick="s_objectID=&quot;http://www.apple.com/privacy/_1&quot;;return
this.s_oc?this.s_oc(e):true">Privacy Policy</a> | Updated:
2018-06-04</p></div></div>

```

```

    <div id="pediaWindow">
        <div id="pediaHeader"></div>
        <div id="pediaBody"></div>
    </div>
</article>

<div id="blackout">
<div id="preload"></div>
</div>
<div id="modal" aria-hidden="true">
    <div id="closebox" tabindex="0" aria-label="Close feedback form"
role="button"></div>
    <div id="sending" class="hidden">
        <h2 tabindex="0">Sending feedback...</h2>
        <div id="sending_img"></div>
    </div>
    <div id="error" class="hidden">
        <h2 tabindex="0">We're sorry, an error has occurred.</h2>
        <p>Please try submitting your feedback later.</p>
        <div id="error_icon"></div>
    </div>
    <div id="success" class="hidden">
        <h2 tabindex="0">Thank you for providing feedback!</h2>
        <p>Your input helps improve our developer documentation.</p>
        <div id="thank_you_icon"></div>
    </div>

    <form id="feedback" action="#" method="post">
        <div class="left-leaf">
            <h2 id="helpful_title" data-asterisk="a1" tabindex="0">How helpful is
this document?</h2>
            <sup id="a1" class="asterisk" aria-hidden="true">*</sup>

            <div id="star_group" role="radiogroup" aria-required="true">
                <label>
                    <input class="radio" type="radio" name="helped" value="1">

```

```

        Very helpful
    </label>
    <label>
        <input class="radio" type="radio" name="helped" value="2">
        Somewhat helpful
    </label>
    <label>
        <input class="radio" type="radio" name="helped" value="3">
        Not helpful
    </label>
</div>
</div>

```

```

<div class="right-leaf">
    <h2>How can we improve this document?</h2>
    <div id="improve" class="checkboxes">

```

```

        <label>
            <input type="checkbox" name="typo">
            Fix typos or links
        </label>
        <label>
            <input type="checkbox" name="infoIncorrect">
            Fix incorrect information
        </label>
        <label>
            <input type="checkbox" name="needs_examples">
            Add or update code samples
        </label>
        <label>
            <input type="checkbox" name="needs_art">
            Add or update illustrations
        </label>
        <label>
            <input type="checkbox" name="missingInfo">
            Add information about...
        </label>
    </div>
</div>

```

```

    <textarea id="comment" name="problem" cols="70" rows="8"
placeholder="Please tell us more about your experience with this document"
data-asterisk="a2" required=""></textarea>

```

```

    <sup id="a2" class="asterisk" aria-hidden="true">*</sup>

```

```

<p class="fineprint">
    <em aria-hidden="true"><span>*</span> Required information</em>
</p>

```

```

<input id="submit" type="button" value="Send">

```

```

<section id="legal">
    <p>

```

```

        To submit a product bug or enhancement request, please visit the
    </p>
</section>

```

```

        <a href="https://developer.apple.com/bugreporter/" target="_blank"
onclick="s_objectID=&quot;https://developer.apple.com/bugreporter/
_1&quot;;return this.s_oc?this.s_oc(e):true">Bug Reporter</a>
    page.
</p>
<p>
    Please read <a href="http://www.apple.com/legal/policies/ideas.html"
target="_blank"
onclick="s_objectID=&quot;http://www.apple.com/legal/policies/ideas.html_1&qu
ot;;return this.s_oc?this.s_oc(e):true">Apple's Unsolicited Idea Submission
Policy</a>
    before you send us your feedback.
</p>
</section>
</form>
</div>

```

```

    <script charset="utf-8"
src="../../Resources/1282/JavaScript/lib/prototype.js"></script>
    <script src="../../Resources/1282/JavaScript/library.js"></script>

```

```

</body></html><html lang="en"><head>
    <title>Voices</title>
    <meta http-equiv="X-UA-Compatible" content="IE=7">
    <meta charset="utf-8">
    <meta id="book-resource-type" name="book-resource-type"
content="Sample Code">
    <meta scheme="apple_ref" id="identifier" name="identifier"
content="//apple_ref/doc/uid/DTS10003699">
    <meta id="document-version" name="document-version" content="2.0.1">
    <meta id="build" name="build"
content="c1e4c7a89af8f899a21cfa81fc33ba42">
    <meta id="chapterId" name="chapterId" content="DTS10003699-Intro">
    <meta id="date" name="date" content="2007-06-25">
    <!-- overview -->
    <meta id="book-title" name="book-title" content="Voices">
    <meta id="book-root" name="book-root" content="..">
    <meta id="book-json" name="book-json" content="../../book.json">
    <meta id="devcenter" name="devcenter" content="Mac Dev Center">
    <meta id="devcenter-url" name="devcenter-url"
content="http://developer.apple.com/devcenter/mac">
    <meta id="reflib" name="reflib" content="Documentation Archive">
    <meta id="book-assignments" name="book-assignments"
content="{Type/Sample Code}, {Topic/Networking, Internet, &amp; Web/Web
Client}">

    <meta name="ROBOTS" content="NOINDEX">
    <meta id="copyright" name="copyright" content="Copyright 2018 Apple Inc.
All Rights Reserved.">
    <meta id="xcode-display" name="xcode-display" content="render">
    <meta id="IndexTitle" name="IndexTitle" content="Voices (Legacy):
Voices">

```

```

    <meta id="resources-uri" name="resources-uri"
content="../../Resources/1282">
    <link id="book-index-page" rel="Start" title="Voices" type="text/html"
href="../../index.html">
    <link id="next-page" rel="Next" type="text/html"
href="../../Listings/Content_Voices_css.html">
    <link id="previous-page" rel="Prev" type="text/html" href="">
    <link rel="stylesheet" type="text/css"
href="../../Resources/1282/CSS/screen.css">

    <!-- xcode_css -->
    <link rel="stylesheet" type="text/css"
href="../../Resources/1282/CSS/feedback.css">
    <meta name="viewport" content="width=device-width, initial-scale=1,
maximum-scale=1">
    <meta id="platforms" name="platforms" content="OS X,Safari">
</head>
<body class="" id=""><a name="//apple_ref/doc/uid/DTS10003699-Intro"
title="Voices"></a>
    <div id="_omniture_top">
    <!-- SiteCatalyst code version: H.8. Copyright 1997-2006 Omniture, Inc. -->
    <script type="text/javascript">
/* RSID: */
var s_account="appleglobal,appleusdeveloper,dappdeveloperlib"
</script>

    <script type="text/javascript"
src="https://www.apple.com/metrics/scripts/s_code_h.js"></script>
    <script type="text/javascript">
s.pageName=AC.Tracking.pageName();
s.channel="www.us.developer"

    /***** DO NOT ALTER ANYTHING BELOW THIS LINE ! *****/
    var s_code=s.t();if(s_code)document.write(s_code)</script>
    <!-- End SiteCatalyst code version: H.8. -->
</div>

    <div id="adcHeader" class="hideOnPrint hideInXcode">
        <div id="ssi_Header" class="hideInXcode unified">
            <a id="ssi_LibraryTitle"
href="https://developer.apple.com/library/archive/navigation/"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
navigation/_1&quot;;return this.s_oc?this.s_oc(e):true">Documentation
Archive</a>
            <a id="ssi_AppleDeveloperConnection"
href="https://developer.apple.com/"
onclick="s_objectID=&quot;https://developer.apple.com/_1&quot;;return
this.s_oc?this.s_oc(e):true">Developer</a>
            <div id="ssi_SearchButton" role="button" title="Search">Search</div>
        </div>
        <form id="ssi_SearchMenu" method="get" action="../../search/" accept-
charset="utf-8">
            <label for="adcsearch">Search Documentation Archive</label>

```

```

        <input type="search" id="ssi_SearchField" name="q" accesskey="s"
results="5">
    </form>
</div>

<header id="header">
    <div id="title" role="banner">
        <h1>Voices</h1>
        <span id="file_links">
            <a id="PDF_link" role="button" tabindex="4" rel="alternate"
title="Download PDF" class=""><span id="pdf_icon"></span>PDF</a>
            <a id="Companion_link" role="button" tabindex="3" title="Download
Companion File" class=""><span id="companion_icon"></span>Companion
File</a>
        </span>
    </div>
    <ul id="headerButtons" class="hideOnPrint" role="toolbar">
        <li id="toc_button" style="">
            <button tabindex="5" id="table_of_contents" class=""
role="checkbox" aria-label="Show Table of Contents"><span
class="disclosure"></span>Table of Contents</button>
        </li>
        <li id="jumpto_button" style="display:none" role="navigation"><select
tabindex="6" id="jumpTo"><option value="top">Jump
To...</option></select></li>
        <li id="downloadSample_button" style="">
            <a id="Sample_link"
href="/library/archive/samplecode/Voices/Voices.zip"><button
id="Sample_button">Download Sample Code</button></a>
        </li>
    </ul>
</header>
<nav id="tocContainer" tabindex="7" class="">
    <ul id="toc" role="tree"><li class=" "
data-aref="//apple_ref/doc/uid/DTS10003699-Intro-
DontLinkElementID_2"><span class="nodisclosure"></span><span
class="sectionName"><a
href="/library/archive/samplecode/Voices/Introduction/Intro.html#//apple_ref/
doc/uid/DTS10003699-Intro-DontLinkElementID_2">About
Voices</a></span></li><li class=" "
data-aref="//apple_ref/doc/uid/DTS10003699-Content_Voices_css-
DontLinkElementID_4"><span class="nodisclosure"></span><span
class="sectionName"><a
href="/library/archive/samplecode/Voices/Listings/Content_Voices_css.html#//
apple_ref/doc/uid/DTS10003699-Content_Voices_css-
DontLinkElementID_4">Content/Voices.css</a></span></li><li class=" " data-
aref="//apple_ref/doc/uid/DTS10003699-Content_Voices_html-
DontLinkElementID_5"><span class="nodisclosure"></span><span
class="sectionName"><a
href="/library/archive/samplecode/Voices/Listings/Content_Voices_html.html#//
apple_ref/doc/uid/DTS10003699-Content_Voices_html-
DontLinkElementID_5">Content/Voices.html</a></span></li><li class=" "

```

```
data-aref="//apple_ref/doc/uid/DTS10003699-Content_Voices_js-
DontLinkElementID_6"><span class="nodisclosure"></span><span
class="sectionName"><a
href="/library/archive/samplecode/Voices/Listings/Content_Voices_js.html#//
apple_ref/doc/uid/DTS10003699-Content_Voices_js-
DontLinkElementID_6">Content/Voices.js</a></span></li><li class=" " data-
aref="//apple_ref/doc/uid/DTS10003699-Voices_wdgt_Voices_css-
DontLinkElementID_7"><span class="nodisclosure"></span><span
class="sectionName"><a
href="/library/archive/samplecode/Voices/Listings/Voices_wdgt_Voices_css.html#
//apple_ref/doc/uid/DTS10003699-Voices_wdgt_Voices_css-
DontLinkElementID_7">Voices.wdgt/Voices.css</a></span></li><li class=" "
data-aref="//apple_ref/doc/uid/DTS10003699-Voices_wdgt_Voices_html-
DontLinkElementID_8"><span class="nodisclosure"></span><span
class="sectionName"><a
href="/library/archive/samplecode/Voices/Listings/Voices_wdgt_Voices_html.html
#//apple_ref/doc/uid/DTS10003699-Voices_wdgt_Voices_html-
DontLinkElementID_8">Voices.wdgt/Voices.html</a></span></li><li class=" "
data-aref="//apple_ref/doc/uid/DTS10003699-Voices_wdgt_Voices_js-
DontLinkElementID_9"><span class="nodisclosure"></span><span
class="sectionName"><a
href="/library/archive/samplecode/Voices/Listings/Voices_wdgt_Voices_js.html#//
apple_ref/doc/uid/DTS10003699-Voices_wdgt_Voices_js-
DontLinkElementID_9">Voices.wdgt/Voices.js</a></span></li><li class=" "
data-aref="//apple_ref/doc/uid/DTS10003699-RevisionHistory-
DontLinkElementID_1"><span class="nodisclosure"></span><span
class="sectionName"><a
href="/library/archive/samplecode/Voices/History/History.html#//apple_ref/doc/
uid/DTS10003699-RevisionHistory-DontLinkElementID_1">Revision
History</a></span></li></ul>
</nav>
```

```
<article id="contents" tabindex="0" role="main" class="">
  <div id="pageNavigationLinks_top" class="pageNavigationLinks">
    <a class="nextLink" rel="next"
href=" ../Listings/Content_Voices_css.html"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
samplecode/Voices/Listings/Content_Voices_css.html_1&quot;;return this.s_oc?
this.s_oc(e):true">Next</a>
  </div>
  <a id="top" name="top"></a>
  <a id="INDEX" href=" ../index.html" style="display:none;"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
samplecode/Voices/index.html_1&quot;;return this.s_oc?this.s_oc(e):true"></a>
  <div id="legacyOuterWrapper" role="alert" class="show"><div
align="center" id="watermark"><div class="legacybox">
<h1>Retired Document<span id="LegacyNoticeCloseBox"
class="closebutton"></span></h1><p><b>Important:</b>
This sample code may not represent best practices for current development. The
project may use deprecated symbols and illustrate technologies and techniques
that are no longer recommended.</p></div></div></div>
  <a name="//apple_ref/doc/uid/DTS10003699" title="Voices"></a><a
name="//apple_ref/doc/uid/DTS10003699-Intro-DontLinkElementID_2"
title="Voices"></a>
```



```

<h1 id="pageTitle">Voices</h1><div class="spec_sheet_info_box"><table
cellspacing="0" class="specbox"><tbody><tr><td
scope="row"><strong><span style="white-space: nowrap;">Last
Revision:</span></strong></td><td><div
class="zSharedSpecBoxHeadList">Version 1.1, 2007-06-25<br>Rearranged to
encourage asynchronous widget.system usage<br><span
class="content_text"><a
href=" ../History/History.html#//apple_ref/doc/uid/DTS10003699-RevisionHistory-
DontLinkElementID_1" data-renderer-version="1" target="_self"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
samplecode/Voices/History/History.html#//apple_ref/do_1&quot;;return this.s_oc?
this.s_oc(e):true">(Full Revision
History)</a></span><br></div></td></tr><tr><td
scope="row"><strong><span style="white-space: nowrap;">Build
Requirements:</span></strong></td><td><div
class="zSharedSpecBoxHeadList">Mac OS X 10.4 or
later</div></td></tr><tr><td scope="row"><strong><span style="white-
space: nowrap;">Runtime Requirements:</span></strong></td><td><div
class="zSharedSpecBoxHeadList">Mac OS X 10.4 or
later</div></td></tr></tbody></table></div>

```

```

<div class="importantbox clear"><aside><a
name="//apple_ref/doc/uid/DTS10003699-Intro-DontLinkElementID_3"
title="Important"></a><p><strong>Important</strong>&nbsp;This sample
code may not represent best practices for current development. The project may
use deprecated symbols and illustrate technologies and techniques that are no
longer recommended.</p><p></p></aside></div>

```

```

<p>This sample widget speaks the text typed into its text field using the
widget.system command. Two different approaches are included: one which
calls widget.system in a synchronous (blocking) fashion, the other in an
asynchronous (non-blocking) fashion. Note that in the synchronous example, all
user interaction is halted while speech is performed. The asynchronous example
is an updated version of the widget found in /Developer/Examples/Dashboard on
Mac OS X 10.4</p>

```

```

<div id="pageNavigationLinks_bottom" class="pageNavigationLinks">
  <a class="nextLink" rel="next"
href=" ../Listings/Content_Voices_css.html"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
samplecode/Voices/Listings/Content_Voices_css.html_2&quot;;return this.s_oc?
this.s_oc(e):true">Next</a>
</div><br>
<div class="copyright"><br><hr><div align="center"><p
class="content_text" lang="en" dir="ltr"> Copyright © 2007 Apple Inc. All
Rights Reserved. <a
href="http://www.apple.com/legal/internet-services/terms/site.html"
target="_blank"

```

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OS 9 & amp; Earlier</a> &gt; </p><div style="width:100%;
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<p><strong>Important: </strong>This document is part of the Legacy section
of the ADC Reference Library. This information should not be used for new
development.</p>

<div class="reflibtopic">

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<a href="#References">References</a><br>
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    <a href="#Downloads">Downloadables</a></p>
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<p>
In the standard system, there are two Command-Shift-number key combinations
that are automatically captured and processed by GetNextEvent.
The combinations are:</p>

<p>Command-Shift-1    Eject internal disk</p>

<p>Command-Shift-2    Eject external disk</p>

<p>Numbers from 3 to 9 are also captured by <code>GetNextEvent</code>,
but are processed by
calling <code>'FKEY'</code> resources. You can implement your own actions
for Command-Shift-number
combinations for numbers 5 to 9 by defining your own <code>'FKEY'</code>
resource. The routine must
have no parameters. The ID of the resource must correspond to the number you
want the
routine to respond to. For example, if you want to define an action for Command-
Shift-8,
you would create an <code>'FKEY'</code> resource with an ID of 8. The
<code>'FKEY'</code> resource should contain

```

the code that you want to execute when the key is pressed.</p>

<p>The following Command-Shift-number key combinations are implemented with <code>'FKEY'</code> resources in the standard System file.</p>

<p>Command-Shift-3</p>

<p>Save current screen as MacPaint file named Screen 0, Screen 1, ... Screen 9 (Works in one-bit mode only on Mac II)</p>

<p>Command-Shift-4 Print the active window (to an ImageWriter)</p>

<p>(with Caps Lock on) Print the entire screen (to an ImageWriter)</p>

<p>Back to top</p>

<h2>References</h2>

<p>The Toolbox Event Manager</p>

<p>Back to top</p>

<p></p>

<h2>Downloadables</h2>

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<p>Download</p>

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<p>Copyright © 2016 Apple Inc. All rights reserved.</p>

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Terms of Use

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                </label>
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The Resource Manager, TextEdit package, List Manager, and
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                    <a href="#Section2">No free database</a><br><br>
                    <a href="#Section3">Words to live by</a><br><br>
                    <a href="#Section4">Checking lists twice</a><br><br>
                    <a href="#Section4">Dialog with the Devil</a><br><br>
                    <a href="#References">References</a><br><br>
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not designed to handle. If extended beyond their design goals, they will become
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<h2>Introduction</h2>

```

<p>Managers to avoid abusing, and the type of abuse:</p>

<p>1) The Resource Manager is not a database.</p>

<p>2) The TextEdit package is not a word processor.</p>

<p>3) The List Manager is not a spreadsheet.</p>

<p>4) The Dialog Manager is not a user interface.</p>

<p>Back to top</p>

<h2>No free database</h2>

<p>After using the Resource Manager for a short time, its virtues become
apparent:

it is very flexible, it is easy to use, it gives disk based I/O with no extra calls,

data can be extracted by either name or ID number, and the data is stored transparently so the caller can pretend the data is always available in a virtual memory fashion. With such wide ranging advantages, it would seem that the Resource Manager should be used for everything. It should be apparent that the TANSTAAFL (There Ain't No Such Thing As A Free Lunch) philosophy applies to the Resource Manager as well. If overextended, the Resource Manager will become slow and unusable.</p>

<p>The Resource Manager is not a database, nor is it a good way to store user data.

Although it can be used to store very small amounts of data, such as configuration data, and features some of the same characteristics of databases in general, the Resource Manager is a specialized tool designed specifically for the types of things that the Macintosh System needs. Its main virtue for system use is that a large variety of data can be stored on disk, and accessed when needed. This is a primitive form of virtual memory which extends the power of the system beyond what the RAM supplies. Remembering that the Resource Manager was written in an era of 128K RAM, it should be apparent that it is optimized to use as little RAM as possible.</p>

<p>The Resource Manager uses a simple data structure for accessing the data in the file. Examining the Resource Manager file format can show some of the tradeoffs expected. For instance, there is a linearly accessed table which describes all of the possible resource types that are in the current file. Without too much thought it should be apparent that if a file is created with thousands of different resource types then access to those resources will be slow. The reason? Each access requires scanning a linear array. There is no hashing technique used on the resource types.</p>

<p>There is a similar linear table for the resource IDs themselves. Based on the previous discussion it should also be apparent that if there are thousands of resources of a specific type that the access time will become much larger. It will be imperceptible on a single access of a resource, but for thousands of accesses to the resource file the time spent traversing the linear list will impact the overall speed of the program. The user will not be pleased.</p>

<p>Increasing the slowness by having too many resources as well as too many types will encourage the user to file the program in a ground based circular storage facility.</p>

<p>As stated inM.TB.MaxResInFile, there is a limit of about 2700 resources in a given file due to the way the resources are stored. The performance penalty will arrive sooner, and the dividing line for where it is "too slow" is a personal preference. As a rule of thumb, if the program has the ability to store more than about 500 resources total (both IDs and types), then consideration should be given to using the Data Fork instead. In particular, if the program allows the user to create data files, do not use the Resource Manager to store the user data. The users will always overextend the use of a program. Plan for it, and avoid making obviously bad decisions. For large amounts of data, the File Manager is the place to look. If the program wants to allow simultaneous (multi-user) access with read and write privileges to data files, then do not use the Resource Manager. Because it caches data, the Resource Manager cannot be relied upon as a multi-user database - even for small amounts of data. This is because there is no way to tell the Resource Manager its cache is invalid.</p>

<p>Don't be fooled by a convenient interface. The Resource Manager is not a database, nor is it a file system.</p>

<p>Back to top</p>

<h2>Words to live by</h2>

<p>Looking at the TextEdit package can give the impression that there is a full featured word processing system built in. This is even more true now that TextEdit has been extended to support various styles and fonts. Unfortunately, appearances are deceiving, and TextEdit is not up to the job of being a word processor. Looking through the documentation shows that there is a 32,767 character limit on the text in a TextEdit record. The <code>teLength</code> is defined as an <code>Integer</code>. Another more subtle limit is the drawing limit of the rectangles surrounding the text. The <code>destRect</code> and <code>viewRect</code> both surround the complete TextEdit record. Using some rather rough approximations, there is an upper limit of about 40 pages of text that can be supported in the QuickDraw rectangle. This is quite a lot for some applications, but is not very many when looking at the job typically required of a word processor. Users do not enjoy breaking their documents into multiple pieces.</p>

<p>There are some other programmatic limitations, not the least of which is

performance. TextEdit will become quite sluggish with large blocks of data. After 2,000-4,000

characters have been stored in a TextEdit record, the performance will have slowed to an unacceptable level.

It is notable that the `lineStarts` array is a linear array of offsets into the edit record. If the data towards the end of the data record (high in the record) changes, the offsets have to be changed.

This can involve updating thousands of `Integer` offsets for every character typed. If the

different font, size and style information is tacked on top of all that, the performance can be

expected to suffer with large blocks of text. Make no mistake about it, a full Macintosh style

word processor is not an easy thing to write. TextEdit was not designed to handle large documents. It was designed as a simple field editor for the Dialog Manager, and extended from there. It was never intended to handle the large jobs expected

of a word processor.

In order to perform the operations required of a word processor it is necessary

to use QuickDraw extensively. The expected Macintosh selection approach with autoscrolling,

typing over selected text, cut/copy/paste, and so on are best implemented using QuickDraw directly.

How the text is stored internally is the primary determining factor on how the word processor will perform.

Don't be fooled by how easy it is to implement simple editing in an application. TextEdit is not a word processor.

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Checking lists twice

The List Manager appears to be a cell oriented display tool, allowing the easy

creation of a spreadsheet interface using system calls. The rich interface to the manager

makes it easy to handle arbitrary lists of data. Or does it? Although the List Manager is very

flexible, easy to use, and general enough to handle graphic elements, its performance becomes

unacceptable with relatively modest amounts of data. A one-dimensional list (like the files

list in StdFile) can be done very well using the List Manager, but with several thousand

items in the list, the performance may not be sufficient. This rarely happens in StdFile

of course, and StdFile was the father of the List Manager. Here again, the tool was

designed with a specific concept in mind, not to be the ultimate tool for handling any possible arbitrary data. A two-dimensional list of data will become too slow to use with an array as small as 10x100. This can hardly be expected to satisfy the user of a spreadsheet, since one "power" criteria is always the number of cells available.</p>

<p>Why so slow? As above, examining the data structures used by the List Manager can tell a lot about the expected performance and limitations. Notably the <code>cellArray</code> used to offset to each cell's data is an old friend, a linear array of <code>Integer</code> offsets. It should come as no surprise that inserting or deleting data from the middle of this array is slow. In order to do those functions the List Manager has to update the <code>Integer</code> offsets in the array each time. It has to step through each element on the linear array of offsets which will take some time on several thousand elements.</p>

<p>The <code>maxIndex</code> field of the ListRec is also notable since it is an <code>Integer</code> as well. The lists of data can be no more than 32K bytes in size, which could be somewhat limiting to a user.</p>

<p>In addition, the List Manager is very general purpose, making it necessary for it to protect itself from bad data whenever possible. It needs to check the bounds of any rectangles it uses for example. It tries to minimize drawing out of bounds, so it checks each cell as it is drawn to be sure that it is on screen. Extra validity checks take some small, but finite, time. As the number of elements grows, the time adds up until it becomes a performance problem. Another limitation brought out by the data structure is the <code>listDefProc</code>, the list definition procedure. Since the List Manager is designed to be as general purpose as possible, it was necessary to add the ability to plug in a new defproc. This has ramifications for speed, however, since all drawing has to go through the bottleneck of the defproc. It won't cost much each time, but it will add up over a large number of cells.</p>

<p>In order to get high performance out of this type of display, it is generally necessary to have as much precalculated as possible. This usually means having data structures which maintain themselves as much as possible, and which do not require changing anything outside of their single cell, thus avoiding impacting the entire display. Linear arrays don't come under this category, since any change impacts all the other cell data in the list. To create a high performance spreadsheet it is usually necessary to go to the QuickDraw level inside of a standard window. It is not typically necessary to be fully general for a specific type of data, so the performance can be improved merely by knowing the type of data expected. To handle large lists of data, the data should be stored in powerful data structures, and displayed with custom routines that know the best way to draw the data.</p>

<p>Don't be fooled by the richness and general purpose interface to the List Manager. The List Manager is not a spreadsheet.</p>

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<h2>Dialog with the Devil</h2>

<p>The Dialog Manager is very attractive. It looks like it will handle windows automatically with no programmer intervention, and can handle a wide variety of elements. It seems to handle controls, static text, editable text, and provides a way to display graphic elements as well. It must be the best possible world since the interface is very straightforward, and so much is done for the caller. At last, a superbly general purpose manager that can be used for any interface. Suddenly, reality rears its ugly head again, and it is interesting to note that this free lunch actually requires more work than doing the same job using the Window Manager, QuickDraw, TextEdit, and the Control Manager. Why? There is a hidden cost in terms of getting the Dialog Manager to do exactly the desired task. Here again, if the end result is supposed to be a simple dialog with a few controls, the Dialog Manager is suited to the job. That is what it was written to do. It was not designed as a way to handle the full interface for applications.</p>

<p>As an example of a hidden cost, what if the interface requires that the program be able to handle a disk inserted event? If this is part of a
<code>ModalDialog</code>,
that requires passing a special <code>filterProc</code> to the dialog when it is called.
It is now necessary to fully understand how the proc gets called, what is legal, and what the proc is required to do. That may not be too hard, but it is time spent on something that has nothing to do with getting the job done; it is only time spent understanding how the Dialog Manager works.</p>

<p>Another example is adding something to a dialog which requires special setup and update routines. Here again, it is not too hard to figure out, but it is time spent trying to tell the Dialog Manager what should be done. There are literally hundreds of these special cases and tough, small problems when trying to extend a dialog past a simple interface. Hundreds of Mac programmers have wasted hundreds (thousands?) of hours finding ways to coerce the Dialog Manager into running a window in a special way.</p>

<p>How about adding a special control to a dialog? Seems straightforward...
How about making it modeless instead? How about moving some items in the dialog off screen? How about moving an EditText item off screen? How about wanting to change the dialog template before the dialog is used? How about all of the above all at the same time?</p>

<p>How about skipping it and using the Window Manager instead?</p>

<p>There are a number of performance penalties for large dialogs as well. A dialog with 50 radio buttons will be unacceptably slow. It should be noted that the Dialog Manager cannot know the desired purpose of the buttons, so it cannot set the button, nor clear another in the same set. In order to implement the actual radio button aspect of a set of controls, it has to be done by the calling program. At this point, the only thing the Dialog Manager is handling is the creation and drawing of the controls, which can easily be done with <code>GetNewControl</code> and <code>DrawControls</code>. The Dialog Manager actually gets in the way of a more complex interface. Looking into the data structures shows that the list of items in a dialog is a linear list. Also of note is that there are no offsets to the various items! This is significant because it means that the Dialog Manager has to drive through the entire list of items for every single operation it performs. If it gets an update event it has to traverse the list. If it gets a mouse event it has to traverse the list. This cannot be expected to be fast with 100 items.</p>

<p>Another performance problem for some programmers is the simple drawing scheme used by the Dialog Manager. If a dialog has some items that are offscreen, they get drawn during update events anyway. The Dialog Manager will traverse the list and draw each item, whether it is on screen or not. This comes from the original design of the Dialog Manager, in that it was never intended to handle hundreds of items, or items off screen.</p>

<p>Some rules of thumb: If there are more than 20 items in the dialog it should be a standard window. If a complicated control like a scroll bar is needed, it should be a standard window. If there are items offscreen, it should be a standard window. If there is a pictorial indicator like a progress indicator, it should be a standard window. If it is a modeless dialog it should be a standard window. If any of the items are movable in the dialog, it should be a standard window. If it is necessary to use a <code>filterProc</code> to add functionality, it should be a standard window. If in doubt, it should probably be a standard window.</p>

<p>Handling a dialog with the Window Manager is very straightforward, much more so than trying to get around the Dialog Manager. There is the standard main event loop, and a conventional case statement to handle the events of interest. If there are controls in the window, they are easily handled with Control Manager calls. Any special items can be added to the case statement with no tricks. Overall there is more code to write, but the code is much less complex (read as: easier to figure out, easier to debug, easier to maintain). In addition, when extra items have to be added to the window, there is an easy-to-find, logical place to add the code. With the Dialog Manager there may

be hidden difficulties.

The Dialog Manager is very powerful, but to use the power it is necessary to use all sorts of hooks, procs, special items, and special calling sequences. As expected, only the interfaces to these things are described in *Inside Macintosh*.

The sequence of events is the costly part. For an example of how to add a `userItem` to a dialog, examine [M.TB.DialogUserItems](#). Note that it is not particularly simple to understand. Contrast that with the `FillRect/FrameRect` calls in the code that handles update events in a normal window.

The Window Manager is more powerful than the Dialog Manager. The Dialog Manager uses the Window Manager. The Window Manager is much more straightforward to use since it follows the conventional Macintosh event model. That model is easier to understand and easier to extend. There are more calls to make, but the overall use is much simpler. There are very few special tricks needed to make any conceivable interface in a window.

Don't be lured in by the "powerful" Dialog Manager calls, tricky hooks, and filter procedures. The Dialog Manager is not a user interface.

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[References](#)

References

The Resource Manager

TextEdit

The List Manager

The Dialog Manager


[M.TB.MaxResInFile](#)

[M.TB.DialogUserItems](#)

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[Downloads](#)

Downloadables

<p align="center"> Acrobat gif</p>	
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<p>Important: This document is part of the Legacy section of the ADC Reference Library. This information should not be used for new development.</p>

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<p>Current information on this Reference Library topic can be found here:</p>

Carbon > Design Guidelines

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<h2>Introduction</h2>

<p>Managers to avoid abusing, and the type of abuse:</p>

```

<p>1) The Resource Manager is not a database.</p>

<p>2) The TextEdit package is not a word processor.</p>

<p>3) The List Manager is not a spreadsheet.</p>

<p>4) The Dialog Manager is not a user interface.</p>

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<h2>No free database</h2>

<p>After using the Resource Manager for a short time, its virtues become apparent:

it is very flexible, it is easy to use, it gives disk based I/O with no extra calls, data can be extracted by either name or ID number, and the data is stored transparently

so the caller can pretend the data is always available in a virtual memory fashion.

With such wide ranging advantages, it would seem that the Resource Manager should

be used for everything. It should be apparent that the TANSTAAFL (There Ain't No

Such Thing As A Free Lunch) philosophy applies to the Resource Manager as well. If overextended, the Resource Manager will become slow and unusable.</p>

<p>The Resource Manager is not a database, nor is it a good way to store user data.

Although it can be used to store very small amounts of data, such as configuration data,

and features some of the same characteristics of databases in general, the Resource Manager

is a specialized tool designed specifically for the types of things that the Macintosh System needs.

Its main virtue for system use is that a large variety of data can be stored on disk, and accessed

when needed. This is a primitive form of virtual memory which extends the power of the system

beyond what the RAM supplies. Remembering that the Resource Manager was written in an era of

128K RAM, it should be apparent that it is optimized to use as little RAM as possible.</p>

<p>The Resource Manager uses a simple data structure for accessing the data in the

file. Examining the Resource Manager file format can show some of the tradeoffs expected.

For instance, there is a linearly accessed table which describes all of the possible resource

types that are in the current file. Without too much thought it should be apparent that if a

file is created with thousands of different resource types then access to those resources

will be slow. The reason? Each access requires scanning a linear array. There is no

hashing technique used on the resource types.</p>

<p>There is a similar linear table for the resource IDs themselves. Based on the previous discussion it should also be apparent that if there are thousands of resources of a specific type that the access time will become much larger. It will be imperceptible on a single access of a resource, but for thousands of accesses to the resource file the time spent traversing the linear list will impact the overall speed of the program. The user will not be pleased.</p>

<p>Increasing the slowness by having too many resources as well as too many types will encourage the user to file the program in a ground based circular storage facility.</p>

<p>As stated inM.TB.MaxResInFile, there is a limit of about 2700 resources in a given file due to the way the resources are stored. The performance penalty will arrive sooner, and the dividing line for where it is "too slow" is a personal preference. As a rule of thumb, if the program has the ability to store more than about 500 resources total (both IDs and types), then consideration should be given to using the Data Fork instead. In particular, if the program allows the user to create data files, do not use the Resource Manager to store the user data. The users will always overextend the use of a program. Plan for it, and avoid making obviously bad decisions. For large amounts of data, the File Manager is the place to look. If the program wants to allow simultaneous (multi-user) access with read and write privileges to data files, then do not use the Resource Manager. Because it caches data, the Resource Manager cannot be relied upon as a multi-user database - even for small amounts of data. This is because there is no way to tell the Resource Manager its cache is invalid.</p>

<p>Don't be fooled by a convenient interface. The Resource Manager is not a database, nor is it a file system.</p>

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<h2>Words to live by</h2>

<p>Looking at the TextEdit package can give the impression that there is a full featured word processing system built in. This is even more true now that TextEdit has been extended to support various styles and fonts. Unfortunately, appearances are deceiving, and TextEdit is not up to the job of being a word processor. Looking through the documentation shows that there is a 32,767 character limit on the text in a TextEdit record. The <code>teLength</code> is

defined as an `Integer`. Another more subtle limit is the drawing limit of the rectangles surrounding the text. The `destRect` and `viewRect` both surround the complete TextEdit record. Using some rather rough approximations, there is an upper limit of about 40 pages of text that can be supported in the QuickDraw rectangle. This is quite a lot for some applications, but is not very many when looking at the job typically required of a word processor. Users do not enjoy breaking their documents into multiple pieces.

There are some other programmatic limitations, not the least of which is performance. TextEdit will become quite sluggish with large blocks of data. After 2,000-4,000 characters have been stored in a TextEdit record, the performance will have slowed to an unacceptable level. It is notable that the `lineStarts` array is a linear array of offsets into the edit record. If the data towards the end of the data record (high in the record) changes, the offsets have to be changed. This can involve updating thousands of `Integer` offsets for every character typed. If the different font, size and style information is tacked on top of all that, the performance can be expected to suffer with large blocks of text. Make no mistake about it, a full Macintosh style word processor is not an easy thing to write. TextEdit was not designed to handle large documents. It was designed as a simple field editor for the Dialog Manager, and extended from there. It was never intended to handle the large jobs expected of a word processor.

In order to perform the operations required of a word processor it is necessary to use QuickDraw extensively. The expected Macintosh selection approach with autoscrolling, typing over selected text, cut/copy/paste, and so on are best implemented using QuickDraw directly. How the text is stored internally is the primary determining factor on how the word processor will perform.

Don't be fooled by how easy it is to implement simple editing in an application. TextEdit is not a word processor.

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Checking lists twice

The List Manager appears to be a cell oriented display tool, allowing the easy

creation of a spreadsheet interface using system calls. The rich interface to the manager makes it easy to handle arbitrary lists of data. Or does it? Although the List Manager is very flexible, easy to use, and general enough to handle graphic elements, its performance becomes unacceptable with relatively modest amounts of data. A one-dimensional list (like the files list in StdFile) can be done very well using the List Manager, but with several thousand items in the list, the performance may not be sufficient. This rarely happens in StdFile of course, and StdFile was the father of the List Manager. Here again, the tool was designed with a specific concept in mind, not to be the ultimate tool for handling any possible arbitrary data. A two-dimensional list of data will become too slow to use with an array as small as 10x100. This can hardly be expected to satisfy the user of a spreadsheet, since one "power" criteria is always the number of cells available.

Why so slow? As above, examining the data structures used by the List Manager can tell a lot about the expected performance and limitations. Notably the `cellArray` used to offset to each cell's data is an old friend, a linear array of `Integer` offsets. It should come as no surprise that inserting or deleting data from the middle of this array is slow. In order to do those functions the List Manager has to update the `Integer` offsets in the array each time. It has to step through each element on the linear array of offsets which will take some time on several thousand elements.

The `maxIndex` field of the ListRec is also notable since it is an `Integer` as well. The lists of data can be no more than 32K bytes in size, which could be somewhat limiting to a user.

In addition, the List Manager is very general purpose, making it necessary for it to protect itself from bad data whenever possible. It needs to check the bounds of any rectangles it uses for example. It tries to minimize drawing out of bounds, so it checks each cell as it is drawn to be sure that it is on screen. Extra validity checks take some small, but finite, time. As the number of elements grows, the time adds up until it becomes a performance problem. Another limitation brought out by the data structure is the `listDefProc`, the list definition procedure. Since the List Manager is designed to be as general purpose as possible, it was necessary to add the ability to plug in a new defproc. This has ramifications for speed, however, since all drawing has to go through the bottleneck of the defproc. It won't cost much each time, but it will add up over a large number of cells.

In order to get high performance out of this type of display, it is generally necessary to have as much precalculated as possible. This usually means having data structures which maintain themselves as much as possible, and which do not require changing anything outside of their single cell, thus avoiding impacting the entire display. Linear arrays don't come under this category, since any change impacts all the other cell data in the list. To create a high performance spreadsheet it is usually necessary to go to the QuickDraw level inside of a standard window. It is not typically necessary to be fully general for a specific type of data, so the performance can be improved merely by knowing the type of data expected. To handle large lists of data, the data should be stored in powerful data structures, and displayed with custom routines that know the best way to draw the data.

Don't be fooled by the richness and general purpose interface to the List Manager. The List Manager is not a spreadsheet.

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[Section 5](#)

Dialog with the Devil

The Dialog Manager is very attractive. It looks like it will handle windows automatically with no programmer intervention, and can handle a wide variety of elements. It seems to handle controls, static text, editable text, and provides a way to display graphic elements as well. It must be the best possible world since the interface is very straightforward, and so much is done for the caller. At last, a superbly general purpose manager that can be used for any interface. Suddenly, reality rears its ugly head again, and it is interesting to note that this free lunch actually requires more work than doing the same job using the Window Manager, QuickDraw, TextEdit, and the Control Manager. Why? There is a hidden cost in terms of getting the Dialog Manager to do exactly the desired task. Here again, if the end result is supposed to be a simple dialog with a few controls, the Dialog Manager is suited to the job. That is what it was written to do. It was not designed as a way to handle the full interface for applications.

As an example of a hidden cost, what if the interface requires that the program be able to handle a disk inserted event? If this is part of a `ModalDialog`, that requires passing a special `filterProc` to the dialog when it is called. It is now necessary to fully understand how the proc gets called, what is legal, and what the proc is required to do. That may not be too hard, but it is time spent on something that has nothing to do with getting the job done; it is only time spent understanding how the Dialog Manager works.

Another example is adding something to a dialog which requires special setup and update routines. Here again, it is not too hard to figure out, but it is time spent trying to tell the Dialog Manager what should be done. There are literally hundreds of these special cases and tough, small problems when trying

to extend a dialog past a simple interface. Hundreds of Mac programmers have wasted hundreds (thousands?) of hours finding ways to coerce the Dialog Manager into running a window in a special way.</p>

<p>How about adding a special control to a dialog? Seems straightforward... How about making it modeless instead? How about moving some items in the dialog off screen? How about moving an EditText item off screen? How about wanting to change the dialog template before the dialog is used? How about all of the above all at the same time?</p>

<p>How about skipping it and using the Window Manager instead?</p>

<p>There are a number of performance penalties for large dialogs as well. A dialog with 50 radio buttons will be unacceptably slow. It should be noted that the Dialog Manager cannot know the desired purpose of the buttons, so it cannot set the button, nor clear another in the same set. In order to implement the actual radio button aspect of a set of controls, it has to be done by the calling program. At this point, the only thing the Dialog Manager is handling is the creation and drawing of the controls, which can easily be done with <code>GetNewControl</code> and <code>DrawControls</code>. The Dialog Manager actually gets in the way of a more complex interface. Looking into the data structures shows that the list of items in a dialog is a linear list. Also of note is that there are no offsets to the various items! This is significant because it means that the Dialog Manager has to drive through the entire list of items for every single operation it performs. If it gets an update event it has to traverse the list. If it gets a mouse event it has to traverse the list. This cannot be expected to be fast with 100 items.</p>

<p>Another performance problem for some programmers is the simple drawing scheme used by the Dialog Manager. If a dialog has some items that are offscreen, they get drawn during update events anyway. The Dialog Manager will traverse the list and draw each item, whether it is on screen or not. This comes from the original design of the Dialog Manager, in that it was never intended to handle hundreds of items, or items off screen.</p>

<p>Some rules of thumb: If there are more than 20 items in the dialog it should be a standard window. If a complicated control like a scroll bar is needed, it should be a standard window. If there are items offscreen, it should be a standard window. If there is a pictorial indicator like a progress indicator, it should be a standard window. If it is a modeless dialog it should be a standard window. If any of the items are movable in the dialog, it should be a standard window. If it is necessary to use a <code>filterProc</code> to add functionality, it should be a standard window. If in doubt, it should probably be a standard window.</p>

<p>Handling a dialog with the Window Manager is very straightforward, much more so

than trying to get around the Dialog Manager. There is the standard main event loop, and a conventional case statement to handle the events of interest. If there are controls in the window, they are easily handled with Control Manager calls. Any special items can be added to the case statement with no tricks. Overall there is more code to write, but the code is much less complex (read as: easier to figure out, easier to debug, easier to maintain). In addition, when extra items have to be added to the window, there is an easy-to-find, logical place to add the code. With the Dialog Manager there may be hidden difficulties.

The Dialog Manager is very powerful, but to use the power it is necessary to use all sorts of hooks, procs, special items, and special calling sequences. As expected, only the interfaces to these things are described in *Inside Macintosh*.

The sequence of events is the costly part. For an example of how to add a `userItem` to a dialog, examine [M.TB.DialogUserItems](../tb/tb_27.html). Note that it is not particularly simple to understand. Contrast that with the `FillRect/FrameRect` calls in the code that handles update events in a normal window.

The Window Manager is more powerful than the Dialog Manager. The Dialog Manager uses the Window Manager. The Window Manager is much more straightforward to use since it follows the conventional Macintosh event model. That model is easier to understand and easier to extend. There are more calls to make, but the overall use is much simpler. There are very few special tricks needed to make any conceivable interface in a window.

Don't be lured in by the "powerful" Dialog Manager calls, tricky hooks, and filter procedures. The Dialog Manager is not a user interface.

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[References](#)

References

The Resource Manager

TextEdit

The List Manager

The Dialog Manager

[M.TB.MaxResInFile](../tb/tb_18.html)

[M.TB.DialogUserItems](../tb/tb_27.html)

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                            <a href="#Section4">Checking lists twice</a><br><br>
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<h2>Introduction</h2>

```

<p>Managers to avoid abusing, and the type of abuse:</p>

<p>1) The Resource Manager is not a database.</p>

<p>2) The TextEdit package is not a word processor.</p>

<p>3) The List Manager is not a spreadsheet.</p>

<p>4) The Dialog Manager is not a user interface.</p>

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<h2>No free database</h2>

<p>After using the Resource Manager for a short time, its virtues become apparent:

it is very flexible, it is easy to use, it gives disk based I/O with no extra calls, data can be extracted by either name or ID number, and the data is stored transparently

so the caller can pretend the data is always available in a virtual memory fashion.

With such wide ranging advantages, it would seem that the Resource Manager should

be used for everything. It should be apparent that the TANSTAAFL (There Ain't No

Such Thing As A Free Lunch) philosophy applies to the Resource Manager as well. If overextended, the Resource Manager will become slow and unusable.</p>

<p>The Resource Manager is not a database, nor is it a good way to store user data.

Although it can be used to store very small amounts of data, such as configuration data,

and features some of the same characteristics of databases in general, the Resource Manager

is a specialized tool designed specifically for the types of things that the Macintosh System needs.

Its main virtue for system use is that a large variety of data can be stored on disk, and accessed

when needed. This is a primitive form of virtual memory which extends the power of the system

beyond what the RAM supplies. Remembering that the Resource Manager was written in an era of 128K RAM, it should be apparent that it is optimized to use as little RAM as possible.

The Resource Manager uses a simple data structure for accessing the data in the file. Examining the Resource Manager file format can show some of the tradeoffs expected. For instance, there is a linearly accessed table which describes all of the possible resource types that are in the current file. Without too much thought it should be apparent that if a file is created with thousands of different resource types then access to those resources will be slow. The reason? Each access requires scanning a linear array. There is no hashing technique used on the resource types.

There is a similar linear table for the resource IDs themselves. Based on the previous discussion it should also be apparent that if there are thousands of resources of a specific type that the access time will become much larger. It will be imperceptible on a single access of a resource, but for thousands of accesses to the resource file the time spent traversing the linear list will impact the overall speed of the program. The user will not be pleased.

Increasing the slowness by having too many resources as well as too many types will encourage the user to file the program in a ground based circular storage facility.

As stated in [M.TB.MaxResInFile](../tb/tb_18.html), there is a limit of about 2700 resources in a given file due to the way the resources are stored. The performance penalty will arrive sooner, and the dividing line for where it is "too slow" is a personal preference. As a rule of thumb, if the program has the ability to store more than about 500 resources total (both IDs and types), then consideration should be given to using the Data Fork instead. In particular, if the program allows the user to create data files, do not use the Resource Manager to store the user data. The users will always overextend the use of a program. Plan for it, and avoid making obviously bad decisions. For large amounts of data, the File Manager is the place to look. If the program wants to allow simultaneous (multi-user) access with read and write privileges to data files, then do not use the Resource Manager. Because it caches data, the Resource Manager cannot be relied upon as a multi-user database - even for small amounts of data. This is because there is no way to tell the Resource Manager its cache is invalid.

<p>Don't be fooled by a convenient interface. The Resource Manager is not a database, nor is it a file system.</p>

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<h2>Words to live by</h2>

<p>Looking at the TextEdit package can give the impression that there is a full featured word processing system built in. This is even more true now that TextEdit has been extended to support various styles and fonts. Unfortunately, appearances are deceiving, and TextEdit is not up to the job of being a word processor. Looking through the documentation shows that there is a 32,767 character limit on the text in a TextEdit record. The <code>teLength</code> is defined as an <code>Integer</code>. Another more subtle limit is the drawing limit of the rectangles surrounding the text. The <code>destRect</code> and <code>viewRect</code> both surround the complete TextEdit record. Using some rather rough approximations, there is an upper limit of about 40 pages of text that can be supported in the QuickDraw rectangle. This is quite a lot for some applications, but is not very many when looking at the job typically required of a word processor. Users do not enjoy breaking their documents into multiple pieces.</p>

<p>There are some other programmatic limitations, not the least of which is performance. TextEdit will become quite sluggish with large blocks of data. After 2,000-4,000 characters have been stored in a TextEdit record, the performance will have slowed to an unacceptable level. It is notable that the <code>lineStarts</code> array is a linear array of offsets into the edit record. If the data towards the end of the data record (high in the record) changes, the offsets have to be changed. This can involve updating thousands of <code>Integer</code> offsets for every character typed. If the different font, size and style information is tacked on top of all that, the performance can be expected to suffer with large blocks of text. Make no mistake about it, a full Macintosh style word processor is not an easy thing to write. TextEdit was not designed to handle large documents. It was designed as a simple field editor for the Dialog Manager, and extended from there. It was never intended to handle the large jobs expected of a word processor.</p>

<p>In order to perform the operations required of a word processor it is necessary to use QuickDraw extensively. The expected Macintosh selection approach with autoscrolling,

typing over selected text, cut/copy/paste, and so on are best implemented using QuickDraw directly.

How the text is stored internally is the primary determining factor on how the word processor will perform.</p>

<p>Don't be fooled by how easy it is to implement simple editing in an application. TextEdit is not a word processor.</p>

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<h2>Checking lists twice</h2>

<p>The List Manager appears to be a cell oriented display tool, allowing the easy creation of a spreadsheet interface using system calls. The rich interface to the manager makes it easy to handle arbitrary lists of data. Or does it? Although the List Manager is very flexible, easy to use, and general enough to handle graphic elements, its performance becomes unacceptable with relatively modest amounts of data. A one-dimensional list (like the files list in StdFile) can be done very well using the List Manager, but with several thousand items in the list, the performance may not be sufficient. This rarely happens in StdFile of course, and StdFile was the father of the List Manager. Here again, the tool was designed with a specific concept in mind, not to be the ultimate tool for handling any possible arbitrary data. A two-dimensional list of data will become too slow to use with an array as small as 10x100. This can hardly be expected to satisfy the user of a spreadsheet, since one "power" criteria is always the number of cells available.</p>

<p>Why so slow? As above, examining the data structures used by the List Manager can tell a lot about the expected performance and limitations. Notably the <code>cellArray</code> used to offset to each cell's data is an old friend, a linear array of <code>Integer</code> offsets. It should come as no surprise that inserting or deleting data from the middle of this array is slow. In order to do those functions the List Manager has to update the <code>Integer</code> offsets in the array each time. It has to step through each element on the linear array of offsets which will take some time on several thousand elements.</p>

<p>The <code>maxIndex</code> field of the ListRec is also notable since it is an <code>Integer</code> as well. The lists of data can be no more than 32K bytes in size, which could be somewhat limiting to a user.</p>

<p>In addition, the List Manager is very general purpose, making it necessary for it to protect itself from bad data whenever possible. It needs to check the bounds of any rectangles it uses for example. It tries to minimize drawing out of bounds, so it checks each cell as it is drawn to be sure that it is on screen. Extra validity checks take some small, but finite, time. As the number of elements grows, the time adds up until it becomes a performance problem. Another limitation brought out by the data structure is the `listDefProc`, the list definition procedure. Since the List Manager is designed to be as general purpose as possible, it was necessary to add the ability to plug in a new defproc. This has ramifications for speed, however, since all drawing has to go through the bottleneck of the defproc. It won't cost much each time, but it will add up over a large number of cells.</p>

<p>In order to get high performance out of this type of display, it is generally necessary to have as much precalculated as possible. This usually means having data structures which maintain themselves as much as possible, and which do not require changing anything outside of their single cell, thus avoiding impacting the entire display. Linear arrays don't come under this category, since any change impacts all the other cell data in the list. To create a high performance spreadsheet it is usually necessary to go to the QuickDraw level inside of a standard window. It is not typically necessary to be fully general for a specific type of data, so the performance can be improved merely by knowing the type of data expected. To handle large lists of data, the data should be stored in powerful data structures, and displayed with custom routines that know the best way to draw the data.</p>

<p>Don't be fooled by the richness and general purpose interface to the List Manager. The List Manager is not a spreadsheet.</p>

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<h2>Dialog with the Devil</h2>

<p>The Dialog Manager is very attractive. It looks like it will handle windows automatically with no programmer intervention, and can handle a wide variety of elements. It seems to handle controls, static text, editable text, and provides a way to display graphic elements as well. It must be the best possible world since the interface is very straightforward, and so much is done for the caller. At last, a superbly general purpose manager that can be used for any interface. Suddenly, reality rears its ugly head again, and it is interesting to note that this free lunch actually requires more work than doing the same job using the Window Manager, QuickDraw, TextEdit, and the Control Manager. Why? There is a hidden cost in terms of getting the Dialog Manager to do exactly the desired task. Here again, if the end result is supposed to be a simple dialog with a few controls, the Dialog Manager is suited to the job. That is what it was written to do. It was not designed as a way to handle the full interface for applications.</p>

<p>As an example of a hidden cost, what if the interface requires that the program be able to handle a disk inserted event? If this is part of a <code>ModalDialog</code>, that requires passing a special <code>filterProc</code> to the dialog when it is called. It is now necessary to fully understand how the proc gets called, what is legal, and what the proc is required to do. That may not be too hard, but it is time spent on something that has nothing to do with getting the job done; it is only time spent understanding how the Dialog Manager works.</p>

<p>Another example is adding something to a dialog which requires special setup and update routines. Here again, it is not too hard to figure out, but it is time spent trying to tell the Dialog Manager what should be done. There are literally hundreds of these special cases and tough, small problems when trying to extend a dialog past a simple interface. Hundreds of Mac programmers have wasted hundreds (thousands?) of hours finding ways to coerce the Dialog Manager into running a window in a special way.</p>

<p>How about adding a special control to a dialog? Seems straightforward... How about making it modeless instead? How about moving some items in the dialog off screen? How about moving an EditText item off screen? How about wanting to change the dialog template before the dialog is used? How about all of the above all at the same time?</p>

<p>How about skipping it and using the Window Manager instead?</p>

<p>There are a number of performance penalties for large dialogs as well. A dialog with 50 radio buttons will be unacceptably slow. It should be noted that the Dialog Manager cannot know the desired purpose of the buttons, so it cannot set the button, nor clear another in the same set. In order to implement the actual radio button aspect of a set of controls, it has to be done by the calling program. At this point, the only thing the Dialog Manager is handling is the creation and drawing of the controls, which can easily be done with <code>GetNewControl</code> and <code>DrawControls</code>. The Dialog Manager actually gets in the way of a more complex interface. Looking into the data structures shows that the list of items in a dialog is a linear list. Also of note is that there are no offsets to the various items! This is significant because it means that the Dialog Manager has to drive through the entire list of items for every single operation it performs. If it gets an update event it has to traverse the list. If it gets a mouse event it has to traverse the list. This cannot be expected to be fast with 100 items.</p>

<p>Another performance problem for some programmers is the simple drawing scheme used by the Dialog Manager. If a dialog has some items that are offscreen, they get drawn during update events anyway. The Dialog Manager will traverse the

list and draw each item, whether it is on screen or not. This comes from the original design of the Dialog Manager, in that it was never intended to handle hundreds of items, or items off screen.</p>

<p>Some rules of thumb: If there are more than 20 items in the dialog it should be a standard window. If a complicated control like a scroll bar is needed, it should be a standard window. If there are items offscreen, it should be a standard window. If there is a pictorial indicator like a progress indicator, it should be a standard window. If it is a modeless dialog it should be a standard window. If any of the items are movable in the dialog, it should be a standard window. If it is necessary to use a `filterProc` to add functionality, it should be a standard window. If in doubt, it should probably be a standard window.</p>

<p>Handling a dialog with the Window Manager is very straightforward, much more so than trying to get around the Dialog Manager. There is the standard main event loop, and a conventional case statement to handle the events of interest. If there are controls in the window, they are easily handled with Control Manager calls. Any special items can be added to the case statement with no tricks. Overall there is more code to write, but the code is much less complex (read as: easier to figure out, easier to debug, easier to maintain). In addition, when extra items have to be added to the window, there is an easy-to-find, logical place to add the code. With the Dialog Manager there may be hidden difficulties.</p>

<p>The Dialog Manager is very powerful, but to use the power it is necessary to use all sorts of hooks, procs, special items, and special calling sequences. As expected, only the interfaces to these things are described in *Inside Macintosh*.

The sequence of events is the costly part. For an example of how to add a `userItem` to a dialog, examine [M.TB.DialogUserItems](http://tb.tb_27.html). Note that it is not particularly simple to understand. Contrast that with the `FillRect/FrameRect` calls in the code that handles update events in a normal window.</p>

<p>The Window Manager is more powerful than the Dialog Manager. The Dialog Manager uses the Window Manager. The Window Manager is much more straightforward to use since it follows the conventional Macintosh event model. That model is easier to understand and easier to extend. There are more calls to make, but the overall use is much simpler. There are very few special tricks needed to make any conceivable interface in a window.</p>

<p>Don't be lured in by the "powerful" Dialog Manager calls, tricky hooks, and filter procedures. The Dialog Manager is not a user interface.</p>

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<h2>References</h2>

<p>The Resource Manager</p>

<p>TextEdit</p>

<p>The List Manager</p>

<p>The Dialog Manager</p>

<p>M.TB.MaxResInFile</p>

<p>M.TB.DialogUserItems</p>

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<h2>Downloadables</h2>

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apple_ref/doc/uid/DTS40011741-Preferences_h-
DontLinkElementID_22">Preferences.h<li class=" " data-
aref="//apple_ref/doc/uid/DTS40011741-Preferences_m-
DontLinkElementID_23"><span
class="sectionName"><a
href="/library/archive/samplecode/TextEdit/Listings/Preferences_m.html#/
apple_ref/doc/uid/DTS40011741-Preferences_m-
DontLinkElementID_23">Preferences.m<li class=" " data-
aref="//apple_ref/doc/uid/DTS40011741-PrintingTextView_h-
DontLinkElementID_26"><span
class="sectionName"><a
href="/library/archive/samplecode/TextEdit/Listings/PrintingTextView_h.html#/
apple_ref/doc/uid/DTS40011741-PrintingTextView_h-
DontLinkElementID_26">PrintingTextView.h<li class=" " data-
aref="//apple_ref/doc/uid/DTS40011741-PrintingTextView_m-
DontLinkElementID_27"><span
class="sectionName"><a
href="/library/archive/samplecode/TextEdit/Listings/PrintingTextView_m.html#/
apple_ref/doc/uid/DTS40011741-PrintingTextView_m-
DontLinkElementID_27">PrintingTextView.m

apple_ref/doc/uid/DTS40011741-PrintingTextView_m-DontLinkElementID_27">PrintingTextView.m<li class=" " data-aref="//apple_ref/doc/uid/DTS40011741-PrintPanelAccessoryController_h-DontLinkElementID_24">PrintPanelAccessoryController.h<li class=" " data-aref="//apple_ref/doc/uid/DTS40011741-PrintPanelAccessoryController_m-DontLinkElementID_25">PrintPanelAccessoryController.m<li class=" " data-aref="//apple_ref/doc/uid/DTS40011741-ScalingScrollView_h-DontLinkElementID_29">ScalingScrollView.h<li class=" " data-aref="//apple_ref/doc/uid/DTS40011741-ScalingScrollView_m-DontLinkElementID_30">ScalingScrollView.m<li class=" " data-aref="//apple_ref/doc/uid/DTS40011741-TextEditDefaultsKeys_h-DontLinkElementID_31">TextEditDefaultsKeys.h<li class=" " data-aref="//apple_ref/doc/uid/DTS40011741-TextEditErrors_h-DontLinkElementID_32">TextEditErrors.h<li class=" " data-aref="//apple_ref/doc/uid/DTS40011741-TextEditMisc_h-DontLinkElementID_33">TextEditMisc.h<li class=" " data-aref="//apple_ref/doc/uid/DTS40011741-RevisionHistory-DontLinkElementID_1">Revision History</nav>

<article id="contents" tabindex="0" role="main" class="">
<div id="pageNavigationLinks_top" class="pageNavigationLinks">

</div>

<h1 id="pageTitle">TextEdit</h1><div class="spec_sheet_info_box"><table cellpadding="0" class="specbox"><tbody><tr><td scope="row">Last Revision:</td><td><div class="zSharedSpecBoxHeadList">Version 1.9, 2013-08-26
Updated for OS X v10.9 Mavericks.
(Full Revision History)
</div></td></tr><tr><td scope="row">Build Requirements:</td><td><div class="zSharedSpecBoxHeadList">Xcode 5.0 or later, OS X v10.9 or later</div></td></tr><tr><td scope="row">Runtime Requirements:</td><td><div class="zSharedSpecBoxHeadList">OS X v10.9 or later.</div></td></tr></tbody></table></div>

<div class="importantbox clear"><aside><p>Important: This document is no longer being updated. For the latest information about Apple SDKs, visit the documentation website</p></div></div>

<p>This sample contains the source code for the TextEdit application. TextEdit is a simple text editor based on the text system in Cocoa.</p>

<div id="pageNavigationLinks_bottom" class="pageNavigationLinks">

```
<a class="nextLink" rel="next" href="../../Listings/ReadMe_txt.html"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
samplecode/TextEdit/Listings/ReadMe_txt.html_2&quot;;return this.s_oc?
this.s_oc(e):true">Next</a>
</div><br>
<div class="copyright"><br><hr><div align="center"><p
class="content_text" lang="en" dir="ltr"> Copyright © 2013 Apple Inc. All
Rights Reserved. <a
href="http://www.apple.com/legal/internet-services/terms/site.html"
target="_blank"
onclick="s_objectID=&quot;http://www.apple.com/legal/internet-services/terms/
site.html_1&quot;;return this.s_oc?this.s_oc(e):true">Terms of Use</a> | <a
href="http://www.apple.com/privacy/" target="_blank"
onclick="s_objectID=&quot;http://www.apple.com/privacy/_1&quot;;return
this.s_oc?this.s_oc(e):true">Privacy Policy</a> | Updated:
2013-08-26</p></div></div>
```

```
<div id="pediaWindow">
  <div id="pediaHeader"></div>
  <div id="pediaBody"></div>
</div>
</article>
```

```
<div id="blackout">
<div id="preload"></div>
</div>
<div id="modal" aria-hidden="true">
  <div id="closebox" tabindex="0" aria-label="Close feedback form"
role="button"></div>
  <div id="sending" class="hidden">
    <h2 tabindex="0">Sending feedback...</h2>
    <div id="sending_img"></div>
  </div>
  <div id="error" class="hidden">
    <h2 tabindex="0">We're sorry, an error has occurred.</h2>
    <p>Please try submitting your feedback later.</p>
    <div id="error_icon"></div>
  </div>
  <div id="success" class="hidden">
    <h2 tabindex="0">Thank you for providing feedback!</h2>
    <p>Your input helps improve our developer documentation.</p>
    <div id="thank_you_icon"></div>
  </div>

  <form id="feedback" action="#" method="post">
    <div class="left-leaf">
      <h2 id="helpful_title" data-asterisk="a1" tabindex="0">How helpful is
this document?</h2>
      <sup id="a1" class="asterisk" aria-hidden="true">*</sup>

      <div id="star_group" role="radiogroup" aria-required="true">
        <label>
          <input class="radio" type="radio" name="helped" value="1">
            Very helpful
```

```

        </label>
        <label>
            <input class="radio" type="radio" name="helped" value="2">
            Somewhat helpful
        </label>
        <label>
            <input class="radio" type="radio" name="helped" value="3">
            Not helpful
        </label>
    </div>
</div>
<div class="right-leaf">
    <h2>How can we improve this document?</h2>
    <div id="improve" class="checkboxes">
        <label>
            <input type="checkbox" name="typo">
            Fix typos or links
        </label>
        <label>
            <input type="checkbox" name="infoIncorrect">
            Fix incorrect information
        </label>
        <label>
            <input type="checkbox" name="needs_examples">
            Add or update code samples
        </label>
        <label>
            <input type="checkbox" name="needs_art">
            Add or update illustrations
        </label>
        <label>
            <input type="checkbox" name="missingInfo">
            Add information about...
        </label>
    </div>
</div>

    <textarea id="comment" name="problem" cols="70" rows="8"
placeholder="Please tell us more about your experience with this document"
data-asterisk="a2" required=""></textarea>
    <sup id="a2" class="asterisk" aria-hidden="true">*</sup>

    <p class="fineprint">
        <em aria-hidden="true"><span>*</span> Required information</em>
    </p>

    <input id="submit" type="button" value="Send">

    <section id="legal">
        <p>
            To submit a product bug or enhancement request, please visit the
            <a href="https://developer.apple.com/bugreporter/" target="_blank"
onclick="s_objectID=&quot;https://developer.apple.com/bugreporter/
_1&quot;;return this.s_oc?this.s_oc(e):true">Bug Reporter</a>

```

```

        page.
    </p>
    <p>
        Please read <a href="http://www.apple.com/legal/policies/ideas.html"
target="_blank"
onclick="s_objectID=&quot;http://www.apple.com/legal/policies/ideas.html_1&qu
ot;;return this.s_oc?this.s_oc(e):true">Apple's Unsolicited Idea Submission
Policy</a>
        before you send us your feedback.
    </p>
</section>
</form>
</div>

```

```

    <script charset="utf-8"
src="../../Resources/1282/JavaScript/lib/prototype.js"></script>
    <script src="../../Resources/1282/JavaScript/library.js"></script>

```

```

</body></html><html lang="en"><head>
    <title>KeychainTouchID: Using Touch ID with Keychain and
LocalAuthentication</title>
    <meta http-equiv="X-UA-Compatible" content="IE=7">
    <meta charset="utf-8">
    <meta id="book-resource-type" name="book-resource-type"
content="Sample Code">
    <meta scheme="apple_ref" id="identifier" name="identifier"
content="//apple_ref/doc/uid/TP40014530">
    <meta id="document-version" name="document-version" content="3.1.0">
    <meta id="build" name="build"
content="c1e4c7a89af8f899a21cfa81fc33ba42">
    <meta id="chapterId" name="chapterId" content="TP40014530-Intro">
    <meta id="date" name="date" content="2018-06-04">
    <meta id="description" name="description" content="Shows how to use
Touch ID with keychain items and how to invoke Touch ID authentication.">
    <meta id="book-title" name="book-title" content="KeychainTouchID: Using
Touch ID with Keychain and LocalAuthentication">
    <meta id="book-root" name="book-root" content="..">
    <meta id="book-json" name="book-json" content="../../book.json">
    <meta id="devcenter" name="devcenter" content="Mac Dev Center">
    <meta id="devcenter-url" name="devcenter-url"
content="http://developer.apple.com/devcenter/mac">
    <meta id="reflib" name="reflib" content="Documentation Archive">
    <meta id="book-assignments" name="book-assignments"
content="{Type/Sample Code}, {Technologies/Core OS
Layer/LocalAuthentication}">

    <meta name="ROBOTS" content="NOINDEX">
    <meta id="copyright" name="copyright" content="Copyright 2018 Apple Inc.
All Rights Reserved.">
    <meta id="xcode-display" name="xcode-display" content="render">

```

```

    <meta id="IndexTitle" name="IndexTitle" content="KeychainTouchID: Using
Touch ID with Keychain and LocalAuthentication (Legacy): KeychainTouchID:
Using Touch ID with Keychain and LocalAuthentication">
    <meta id="resources-uri" name="resources-uri"
content="../../Resources/1282">
    <link id="book-index-page" rel="Start" title="KeychainTouchID: Using Touch
ID with Keychain and LocalAuthentication" type="text/html"
href="../../index.html">
    <link id="next-page" rel="Next" type="text/html"
href="../../Listings/KeychainTouchID_main_m.html">
    <link id="previous-page" rel="Prev" type="text/html" href="">
    <link rel="stylesheet" type="text/css"
href="../../Resources/1282/CSS/screen.css">

    <!-- xcode_css -->
    <link rel="stylesheet" type="text/css"
href="../../Resources/1282/CSS/feedback.css">
    <meta name="viewport" content="width=device-width, initial-scale=1,
maximum-scale=1">
    <meta id="platforms" name="platforms" content="iOS">
</head>
<body class="" id=""><a name="//apple_ref/doc/uid/TP40014530-Intro"
title="KeychainTouchID: Using Touch ID with Keychain and
LocalAuthentication"></a>
    <div id="_omniture_top">
    <!-- SiteCatalyst code version: H.8. Copyright 1997-2006 Omniture, Inc. -->
    <script type="text/javascript">
/* RSID: */
var s_account="appleglobal,appleusdeveloper,dappdeveloperlib"
</script>

    <script type="text/javascript"
src="https://www.apple.com/metrics/scripts/s_code_h.js"></script>
    <script type="text/javascript">
s.pageName=AC.Tracking.pageName();
s.channel="www.us.developer"

    /***** DO NOT ALTER ANYTHING BELOW THIS LINE ! *****/
var s_code=s.t();if(s_code)document.write(s_code)</script>
    <!-- End SiteCatalyst code version: H.8. -->
</div>

    <div id="adcHeader" class="hideOnPrint hideInXcode">
    <div id="ssi_Header" class="hideInXcode unified">
    <a id="ssi_LibraryTitle"
href="https://developer.apple.com/library/archive/navigation/"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
navigation/_1&quot;;return this.s_oc?this.s_oc(e):true">Documentation
Archive</a>
    <a id="ssi_AppleDeveloperConnection"
href="https://developer.apple.com/"
onclick="s_objectID=&quot;https://developer.apple.com/_1&quot;;return
this.s_oc?this.s_oc(e):true">Developer</a>
    <div id="ssi_SearchButton" role="button" title="Search">Search</div>

```

```

</div>
<form id="ssi_SearchMenu" method="get" action="../../search/" accept-
charset="utf-8">
  <label for="adcsearch">Search Documentation Archive</label>

  <input type="search" id="ssi_SearchField" name="q" accesskey="s"
results="5">
</form>
</div>

<header id="header">
  <div id="title" role="banner">
    <h1>KeychainTouchID: Using Touch ID with Keychain and
LocalAuthentication</h1>
    <span id="file_links">
      <a id="PDF_link" role="button" tabindex="4" rel="alternate"
title="Download PDF" class=""><span id="pdf_icon"></span>PDF</a>
      <a id="Companion_link" role="button" tabindex="3" title="Download
Companion File" class=""><span id="companion_icon"></span>Companion
File</a>
    </span>
  </div>
  <ul id="headerButtons" class="hideOnPrint" role="toolbar">
    <li id="toc_button" style="">
      <button tabindex="5" id="table_of_contents" class=""
role="checkbox" aria-label="Show Table of Contents"><span
class="disclosure"></span>Table of Contents</button>
    </li>
    <li id="jumpto_button" style="display:none" role="navigation"><select
tabindex="6" id="jumpTo"><option value="top">Jump
To...</option></select></li>
    <li id="downloadSample_button" style="">
      <a id="Sample_link"
href="/library/archive/samplecode/KeychainTouchID/KeychainTouchIDUsingTouc
hIDwithKeychainandLocalAuthentication.zip"><button
id="Sample_button">Download Sample Code</button></a>
    </li>
  </ul>
</header>
<nav id="tocContainer" tabindex="7" class="">
  <ul id="toc" role="tree"><li class=" "
data-aref="//apple_ref/doc/uid/TP40014530-Intro-DontLinkElementID_2"><span
class="nodisclosure"></span><span class="sectionName"><a
href="/library/archive/samplecode/KeychainTouchID/Introduction/Intro.html#//
apple_ref/doc/uid/TP40014530-Intro-DontLinkElementID_2">About
KeychainTouchID: Using Touch ID with Keychain and
LocalAuthentication</a></span></li><li class=" "
data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_main_m-
DontLinkElementID_14"><span class="nodisclosure"></span><span
class="sectionName"><a
href="/library/archive/samplecode/KeychainTouchID/Listings/KeychainTouchID_m
ain_m.html#//apple_ref/doc/uid/TP40014530-KeychainTouchID_main_m-

```


DontLinkElementID_14">KeychainTouchID/main.m<li class=" " data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLTest_m-DontLinkElementID_13">KeychainTouchID/AAPLTest.m<li class=" " data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLAppDelegate_m-DontLinkElementID_5">KeychainTouchID/AAPLAppDelegate.m<li class=" " data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLBasicTestViewController_h-DontLinkElementID_6">KeychainTouchID/AAPLBasicTestViewController.h<li class=" " data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLBasicTestViewController_m-DontLinkElementID_7">KeychainTouchID/AAPLBasicTestViewController.m<li class=" " data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLKeychainTestsViewController_m-DontLinkElementID_9">KeychainTouchID/AAPLKeychainTestsViewController.m<li class=" " data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLLocalAuthenticationTestsViewController_h-DontLinkElementID_10">KeychainTouchID/AAPLLocalAuthenticationTestsViewController.h<li class=" " data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLLocalAuthenticationTestsViewController_m-DontLinkElementID_11">KeychainTouchID/

AAPLLocalAuthenticationTestsViewController.m

- [data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLKeychainTestsViewController_h-DontLinkElementID_8" class="nodisclosure" class="sectionName" href="/library/archive/samplecode/KeychainTouchID/Listings/KeychainTouchID_AAPLKeychainTestsViewController_h.html#apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLKeychainTestsViewController_h-DontLinkElementID_8">KeychainTouchID/AAPLKeychainTestsViewController.h](#)
- [data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLTest_h-DontLinkElementID_12" class="nodisclosure" class="sectionName" href="/library/archive/samplecode/KeychainTouchID/Listings/KeychainTouchID_AAPLTest_h.html#apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLTest_h-DontLinkElementID_12">KeychainTouchID/AAPLTest.h](#)
- [data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLAppDelegate_h-DontLinkElementID_4" class="nodisclosure" class="sectionName" href="/library/archive/samplecode/KeychainTouchID/Listings/KeychainTouchID_AAPLAppDelegate_h.html#apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLAppDelegate_h-DontLinkElementID_4">KeychainTouchID/AAPLAppDelegate.h](#)
- [data-aref="//apple_ref/doc/uid/TP40014530-README_md-DontLinkElementID_16" class="nodisclosure" class="sectionName" href="/library/archive/samplecode/KeychainTouchID/Listings/README_md.html#apple_ref/doc/uid/TP40014530-README_md-DontLinkElementID_16">README.md](#)
- [data-aref="//apple_ref/doc/uid/TP40014530-LICENSE_txt-DontLinkElementID_15" class="nodisclosure" class="sectionName" href="/library/archive/samplecode/KeychainTouchID/Listings/LICENSE_txt.html#apple_ref/doc/uid/TP40014530-LICENSE_txt-DontLinkElementID_15">LICENSE.txt](#)
- [data-aref="//apple_ref/doc/uid/TP40014530-RevisionHistory-DontLinkElementID_1" class="nodisclosure" class="sectionName" href="/library/archive/samplecode/KeychainTouchID/History/History.html#apple_ref/doc/uid/TP40014530-RevisionHistory-DontLinkElementID_1">Revision History](#)

</nav>

<article id="contents" tabindex="0" role="main" class="">

<div id="pageNavigationLinks_top" class="pageNavigationLinks">

<a class="nextLink" rel="next"

href="../../Listings/KeychainTouchID_main_m.html"

onclick="s_objectID="https://developer.apple.com/library/archive/samplecode/KeychainTouchID/Listings/KeychainTouchID_m_1";return this.s_oc?this.s_oc(e):true">Next

</div>

<a id="INDEX" href="../../index.html" style="display:none;" onclick="s_objectID="https://developer.apple.com/library/archive/

samplecode/KeychainTouchID/index.html_1" return this.s_oc?this.s_oc(e):true">

Retired Document</h1><p>Important: This document may not represent best practices for current development. Links to downloads and other resources may no longer be valid.</p></div></div></div>

[](//apple_ref/doc/uid/TP40014530 "KeychainTouchID: Using Touch ID with Keychain and LocalAuthentication")

KeychainTouchID: Using Touch ID with Keychain and LocalAuthentication</h1> | | |--| | <div> <div>scope="row">Last Revision:</div></td><td><div class="zSharedSpecBoxHeadList">Version 3.0, 2018-06-04
Moved to Retired Documents Library.
(Full Revision History)
</div></td><td><div scope="row">Build Requirements:</div></td><td><div class="zSharedSpecBoxHeadList">Xcode 8.0; iOS 10.0 SDK or later</div></td><td><div scope="row">Runtime Requirements:</div></td><td><div class="zSharedSpecBoxHeadList">iOS 10.0 or later</div></td></tr></tbody></table></div> <div class="importantbox clear"> <div> <div>name="//apple_ref/doc/uid/TP40014530-Intro-DontLinkElementID_3" title="Important:"></div><p>Important:&nbsp;This document may not represent best practices for current development. Links to downloads and other resources may no longer be valid.</p><p></p></div></div> <p>The KeychainTouchID sample shows how to store Touch ID protected items to the keychain and how to query for those items with custom message prompts. You'll see how to use the keychain item accessibility class, which invalidates items when the passcode is removed. You'll also find out how to use the LocalAuthentication class to invoke Touch ID verification without involving the keychain.</p></p></div> </div> <div class="pageNavigationLinks" id="pageNavigationLinks_bottom">></div> </div></div></div> | |--|

```
        <a class="nextLink" rel="next"
href="../Listings/KeychainTouchID_main_m.html"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
samplecode/KeychainTouchID/Listings/KeychainTouchID_m_2&quot;;return
this.s_oc?this.s_oc(e):true">Next</a>
    </div><br>
    <div class="copyright"><br><hr><div align="center"><p
class="content_text" lang="en" dir="ltr"> Copyright © 2018 Apple Inc. All
Rights Reserved. <a
href="http://www.apple.com/legal/internet-services/terms/site.html"
target="_blank"
onclick="s_objectID=&quot;http://www.apple.com/legal/internet-services/terms/
site.html_1&quot;;return this.s_oc?this.s_oc(e):true">Terms of Use</a> | <a
href="http://www.apple.com/privacy/" target="_blank"
onclick="s_objectID=&quot;http://www.apple.com/privacy/_1&quot;;return
this.s_oc?this.s_oc(e):true">Privacy Policy</a> | Updated:
2018-06-04</p></div></div>
```

```
    <div id="pediaWindow">
        <div id="pediaHeader"></div>
        <div id="pediaBody"></div>
    </div>
</article>
```

```
<script charset="utf-8"
src="../../Resources/1282/JavaScript/lib/prototype.js"></script>
<script src="../../Resources/1282/JavaScript/library.js"></script>
```

```
</body></html>
```

```
<html lang="en"><head>
    <title>KeychainTouchID: Using Touch ID with Keychain and
LocalAuthentication</title>
    <meta http-equiv="X-UA-Compatible" content="IE=7">
    <meta charset="utf-8">
    <meta id="book-resource-type" name="book-resource-type"
content="Sample Code">
    <meta scheme="apple_ref" id="identifier" name="identifier"
content="//apple_ref/doc/uid/TP40014530">
    <meta id="document-version" name="document-version" content="3.1.0">
    <meta id="build" name="build"
content="c1e4c7a89af8f899a21cfa81fc33ba42">
    <meta id="chapterId" name="chapterId" content="TP40014530-Intro">
    <meta id="date" name="date" content="2018-06-04">
    <meta id="description" name="description" content="Shows how to use
Touch ID with keychain items and how to invoke Touch ID authentication.">
    <meta id="book-title" name="book-title" content="KeychainTouchID: Using
Touch ID with Keychain and LocalAuthentication">
    <meta id="book-root" name="book-root" content="../">
    <meta id="book-json" name="book-json" content="../../book.json">
    <meta id="devcenter" name="devcenter" content="Mac Dev Center">
```

```

    <meta id="devcenter-url" name="devcenter-url"
content="http://developer.apple.com/devcenter/mac">
    <meta id="reflib" name="reflib" content="Documentation Archive">
    <meta id="book-assignments" name="book-assignments"
content="{Type/Sample Code}, {Technologies/Core OS
Layer/LocalAuthentication}">

    <meta name="ROBOTS" content="NOINDEX">
    <meta id="copyright" name="copyright" content="Copyright 2018 Apple Inc.
All Rights Reserved.">
    <meta id="xcode-display" name="xcode-display" content="render">
    <meta id="IndexTitle" name="IndexTitle" content="KeychainTouchID: Using
Touch ID with Keychain and LocalAuthentication (Legacy): KeychainTouchID:
Using Touch ID with Keychain and LocalAuthentication">
    <meta id="resources-uri" name="resources-uri"
content="../../Resources/1282">
    <link id="book-index-page" rel="Start" title="KeychainTouchID: Using Touch
ID with Keychain and LocalAuthentication" type="text/html"
href="../../index.html">
    <link id="next-page" rel="Next" type="text/html"
href="../../Listings/KeychainTouchID_main_m.html">
    <link id="previous-page" rel="Prev" type="text/html" href="">
    <link rel="stylesheet" type="text/css"
href="../../Resources/1282/CSS/screen.css">

    <!-- xcode_css -->
    <link rel="stylesheet" type="text/css"
href="../../Resources/1282/CSS/feedback.css">
    <meta name="viewport" content="width=device-width, initial-scale=1,
maximum-scale=1">
    <meta id="platforms" name="platforms" content="iOS">
</head>
<body class="" id=""><a name="//apple_ref/doc/uid/TP40014530-Intro"
title="KeychainTouchID: Using Touch ID with Keychain and
LocalAuthentication"></a>
    <div id="_omniture_top">
    <!-- SiteCatalyst code version: H.8. Copyright 1997-2006 Omniture, Inc. -->
    <script type="text/javascript">
/* RSID: */
var s_account="appleglobal,appleusdeveloper,dappdeveloperlib"
</script>

    <script type="text/javascript"
src="https://www.apple.com/metrics/scripts/s_code_h.js"></script>
    <script type="text/javascript">
s.pageName=AC.Tracking.pageName();
s.channel="www.us.developer"

    /***** DO NOT ALTER ANYTHING BELOW THIS LINE ! *****/
    var s_code=s.t();if(s_code)document.write(s_code)</script>
    <!-- End SiteCatalyst code version: H.8. -->
    </div>

    <div id="adcHeader" class="hideOnPrint hideInXcode">

```

```

        <div id="ssi_Header" class="hideInXcode unified">
            <a id="ssi_LibraryTitle"
href="https://developer.apple.com/library/archive/navigation/"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
navigation/_1&quot;;return this.s_oc?this.s_oc(e):true">Documentation
Archive</a>
            <a id="ssi_AppleDeveloperConnection"
href="https://developer.apple.com/"
onclick="s_objectID=&quot;https://developer.apple.com/_1&quot;;return
this.s_oc?this.s_oc(e):true">Developer</a>
            <div id="ssi_SearchButton" role="button" title="Search">Search</div>
        </div>
        <form id="ssi_SearchMenu" method="get" action="../../search/" accept-
charset="utf-8">
            <label for="adcsearch">Search Documentation Archive</label>

            <input type="search" id="ssi_SearchField" name="q" accesskey="s"
results="5">
        </form>
    </div>

    <header id="header">
        <div id="title" role="banner">
            <h1>KeychainTouchID: Using Touch ID with Keychain and
LocalAuthentication</h1>
            <span id="file_links">
                <a id="PDF_link" role="button" tabindex="4" rel="alternate"
title="Download PDF" class=""><span id="pdf_icon"></span>PDF</a>
                <a id="Companion_link" role="button" tabindex="3" title="Download
Companion File" class=""><span id="companion_icon"></span>Companion
File</a>
            </span>
        </div>
        <ul id="headerButtons" class="hideOnPrint" role="toolbar">
            <li id="toc_button" style="">
                <button tabindex="5" id="table_of_contents" class=""
role="checkbox" aria-label="Show Table of Contents"><span
class="disclosure"></span>Table of Contents</button>
            </li>
            <li id="jumpto_button" style="display:none" role="navigation"><select
tabindex="6" id="jumpTo"><option value="top">Jump
To...</option></select></li>
            <li id="downloadSample_button" style="">
                <a id="Sample_link"
href="/library/archive/samplecode/KeychainTouchID/KeychainTouchIDUsingTouc
hIDwithKeychainandLocalAuthentication.zip"><button
id="Sample_button">Download Sample Code</button></a>
            </li>
        </ul>
    </header>
    <nav id="tocContainer" tabindex="7" class="">

```

```
<ul id="toc" role="tree"><li class=" "
data-aref="//apple_ref/doc/uid/TP40014530-Intro-DontLinkElementID_2"><span
class="nodisclosure"></span><span class="sectionName"><a
href="//library/archive/samplecode/KeychainTouchID/Introduction/Intro.html#//
apple_ref/doc/uid/TP40014530-Intro-DontLinkElementID_2">About
KeychainTouchID: Using Touch ID with Keychain and
LocalAuthentication</a></span></li><li class=" "
data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_main_m-
DontLinkElementID_14"><span class="nodisclosure"></span><span
class="sectionName"><a
href="//library/archive/samplecode/KeychainTouchID/Listings/KeychainTouchID_m
ain_m.html#//apple_ref/doc/uid/TP40014530-KeychainTouchID_main_m-
DontLinkElementID_14">KeychainTouchID/main.m</a></span></li><li class="
" data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLTest_m-
DontLinkElementID_13"><span class="nodisclosure"></span><span
class="sectionName"><a
href="//library/archive/samplecode/KeychainTouchID/Listings/KeychainTouchID_A
APLTest_m.html#//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLTest_m-
DontLinkElementID_13">KeychainTouchID/AAPLTest.m</a></span></li><li
class=" " data-aref="//apple_ref/doc/uid/TP40014530-
KeychainTouchID_AAPLAppDelegate_m-DontLinkElementID_5"><span
class="nodisclosure"></span><span class="sectionName"><a
href="//library/archive/samplecode/KeychainTouchID/Listings/KeychainTouchID_A
APLAppDelegate_m.html#//apple_ref/doc/uid/TP40014530-
KeychainTouchID_AAPLAppDelegate_m-
DontLinkElementID_5">KeychainTouchID/AAPLAppDelegate.m</a></span></
li><li class=" " data-aref="//apple_ref/doc/uid/TP40014530-
KeychainTouchID_AAPLBasicTestViewController_h-DontLinkElementID_6"><span
class="nodisclosure"></span><span class="sectionName"><a
href="//library/archive/samplecode/KeychainTouchID/Listings/KeychainTouchID_A
APLBasicTestViewController_h.html#//apple_ref/doc/uid/TP40014530-
KeychainTouchID_AAPLBasicTestViewController_h-
DontLinkElementID_6">KeychainTouchID/AAPLBasicTestViewController.h</
a></span></li><li class=" " data-aref="//apple_ref/doc/uid/TP40014530-
KeychainTouchID_AAPLBasicTestViewController_m-DontLinkElementID_7"><span
class="nodisclosure"></span><span class="sectionName"><a
href="//library/archive/samplecode/KeychainTouchID/Listings/KeychainTouchID_A
APLBasicTestViewController_m.html#//apple_ref/doc/uid/TP40014530-
KeychainTouchID_AAPLBasicTestViewController_m-
DontLinkElementID_7">KeychainTouchID/AAPLBasicTestViewController.m</
a></span></li><li class=" " data-aref="//apple_ref/doc/uid/TP40014530-
KeychainTouchID_AAPLKeychainTestsViewController_m-
DontLinkElementID_9"><span class="nodisclosure"></span><span
class="sectionName"><a
href="//library/archive/samplecode/KeychainTouchID/Listings/KeychainTouchID_A
APLKeychainTestsViewController_m.html#//apple_ref/doc/uid/TP40014530-
KeychainTouchID_AAPLKeychainTestsViewController_m-
DontLinkElementID_9">KeychainTouchID/
AAPLKeychainTestsViewController.m</a></span></li><li class=" " data-
aref="//apple_ref/doc/uid/TP40014530-
KeychainTouchID_AAPLLocalAuthenticationTestsViewController_h-
DontLinkElementID_10"><span class="nodisclosure"></span><span
class="sectionName"><a
href="//library/archive/samplecode/KeychainTouchID/Listings/KeychainTouchID_A
```

APLLocalAuthenticationTestsViewController_h.html#//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLLocalAuthenticationTestsViewController_h-DontLinkElementID_10">KeychainTouchID/AAPLLocalAuthenticationTestsViewController.h<li class=" " data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLLocalAuthenticationTestsViewController_m-DontLinkElementID_11">KeychainTouchID/AAPLLocalAuthenticationTestsViewController.m<li class=" " data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLKeychainTestsViewController_h-DontLinkElementID_8">KeychainTouchID/AAPLKeychainTestsViewController.h<li class=" " data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLTest_h-DontLinkElementID_12">KeychainTouchID/AAPLTest.h<li class=" " data-aref="//apple_ref/doc/uid/TP40014530-KeychainTouchID_AAPLAppDelegate_h-DontLinkElementID_4">KeychainTouchID/AAPLAppDelegate.h<li class=" " data-aref="//apple_ref/doc/uid/TP40014530-README_md-DontLinkElementID_16">README.md<li class=" " data-aref="//apple_ref/doc/uid/TP40014530-LICENSE_txt-DontLinkElementID_15">LICENSE.txt<li class=" " data-aref="//apple_ref/doc/uid/TP40014530-RevisionHistory-DontLinkElementID_1">Revision History</nav>


```

<article id="contents" tabindex="0" role="main" class="">
  <div id="pageNavigationLinks_top" class="pageNavigationLinks">
    <a class="nextLink" rel="next"
href=" ../Listings/KeychainTouchID_main_m.html"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
samplecode/KeychainTouchID/Listings/KeychainTouchID_m_1&quot;;return
this.s_oc?this.s_oc(e):true">Next</a>
  </div>
  <a id="top" name="top"></a>
  <a id="INDEX" href=" ../index.html" style="display:none;"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
samplecode/KeychainTouchID/index.html_1&quot;;return this.s_oc?
this.s_oc(e):true"></a>
  <div id="legacyOuterWrapper" role="alert" class="show"><div
align="center" id="watermark"><div class="legacybox">
<h1>Retired Document<span id="LegacyNoticeCloseBox"
class="closebutton"></span></h1><p><b>Important:</b>
This document may not represent best practices for current development. Links
to downloads and other resources may no longer be
valid.</p></div></div></div>
  <a name="//apple_ref/doc/uid/TP40014530" title="KeychainTouchID: Using
Touch ID with Keychain and LocalAuthentication"></a><a
name="//apple_ref/doc/uid/TP40014530-Intro-DontLinkElementID_2"
title="KeychainTouchID: Using Touch ID with Keychain and
LocalAuthentication"></a>
  <h1 id="pageTitle">KeychainTouchID: Using Touch ID with Keychain and
LocalAuthentication</h1><div class="spec_sheet_info_box"><table
cellspacing="0" class="specbox"><tbody><tr><td
scope="row"><strong><span style="white-space: nowrap;">Last
Revision:</span></strong></td><td><div
class="zSharedSpecBoxHeadList">Version 3.0, 2018-06-04<br>Moved to
Retired Documents Library.<br><span class="content_text"><a
href=" ../History/History.html#//apple_ref/doc/uid/TP40014530-RevisionHistory-
DontLinkElementID_1" data-renderer-version="1" target="_self"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
samplecode/KeychainTouchID/History/History.html#//app_1&quot;;return
this.s_oc?this.s_oc(e):true">(Full Revision
History)</a></span><br></div></td></tr><tr><td
scope="row"><strong><span style="white-space: nowrap;">Build
Requirements:</span></strong></td><td><div
class="zSharedSpecBoxHeadList">Xcode 8.0; iOS 10.0 SDK or
later</div></td></tr><tr><td scope="row"><strong><span style="white-
space: nowrap;">Runtime Requirements:</span></strong></td><td><div
class="zSharedSpecBoxHeadList">iOS 10.0 or
later</div></td></tr></tbody></table></div>
  <div class="importantbox clear"><aside><a
name="//apple_ref/doc/uid/TP40014530-Intro-DontLinkElementID_3"
title="Important:"></a><p><strong>Important:</strong>&nbsp;This
document may not represent best practices for current development. Links to
downloads and other resources may no longer be
valid.</p><p></p></aside></div>
  <p>The KeychainTouchID sample shows how to store Touch ID protected
items to the keychain and how to query for those items with custom message
prompts. You'll see how to use the keychain item accessibility class, which

```

invalidates items when the passcode is removed. You'll also find out how to use the LocalAuthentication class to invoke Touch ID verification without involving the keychain.</p>

```
<div id="pageNavigationLinks_bottom" class="pageNavigationLinks">
  <a class="nextLink" rel="next"
href=" ../Listings/KeychainTouchID_main_m.html"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
samplecode/KeychainTouchID/Listings/KeychainTouchID_m_2&quot;;return
this.s_oc?this.s_oc(e):true">Next</a>
</div><br>
<div class="copyright"><br><hr><div align="center"><p
class="content_text" lang="en" dir="ltr"> Copyright © 2018 Apple Inc. All
Rights Reserved. <a
href="http://www.apple.com/legal/internet-services/terms/site.html"
target="_blank"
onclick="s_objectID=&quot;http://www.apple.com/legal/internet-services/terms/
site.html_1&quot;;return this.s_oc?this.s_oc(e):true">Terms of Use</a> | <a
href="http://www.apple.com/privacy/" target="_blank"
onclick="s_objectID=&quot;http://www.apple.com/privacy/_1&quot;;return
this.s_oc?this.s_oc(e):true">Privacy Policy</a> | Updated:
2018-06-04</p></div></div>
```

```
<div id="pediaWindow">
  <div id="pediaHeader"></div>
  <div id="pediaBody"></div>
</div>
</article>
```

```
<script charset="utf-8"
src=" ../ ../Resources/1282/JavaScript/lib/prototype.js"></script>
<script src=" ../ ../Resources/1282/JavaScript/library.js"></script>
```

```
</body></html><html lang="en"><head>
```

```
<title>About Text Handling in iOS</title>
<meta http-equiv="X-UA-Compatible" content="IE=7">
<meta charset="utf-8">
<meta id="book-resource-type" name="book-resource-type"
content="Guide">
<meta scheme="apple_ref" id="identifier" name="identifier"
content="//apple_ref/doc/uid/TP40009542">
<meta id="document-version" name="document-version" content="4.1.0">
<meta id="build" name="build"
content="c1e4c7a89af8f899a21cfa81fc33ba42">
```

```

    <meta id="chapterId" name="chapterId" content="TP40009542-CH1">
    <meta id="date" name="date" content="2018-01-16">
    <meta id="description" name="description" content="Describes the
technologies and techniques for displaying and managing text and web content
in iOS.">
    <meta id="book-title" name="book-title" content="Text Programming Guide
for iOS">
    <meta id="book-root" name="book-root" content="..">
    <meta id="book-json" name="book-json" content="../book.json">
    <meta id="devcenter" name="devcenter" content="Mac Dev Center">
    <meta id="devcenter-url" name="devcenter-url"
content="http://developer.apple.com/devcenter/mac">
    <meta id="reflib" name="reflib" content="Documentation Archive">
    <meta id="book-assignments" name="book-assignments"
content="{Type/Guide}, {Technologies/Cocoa Layer/UIKit}, {Topic/Data
Management/Strings, Text, & Fonts}">

    <meta id="copyright" name="copyright" content="Copyright 2018 Apple Inc.
All Rights Reserved.">
    <meta id="xcode-display" name="xcode-display" content="render">
    <meta id="IndexTitle" name="IndexTitle" content="Text Programming Guide
for iOS: About Text Handling in iOS">
    <meta id="resources-uri" name="resources-uri"
content="../../../../../Resources/1282">
    <link id="book-index-page" rel="Start" title="Text Programming Guide for
iOS" type="text/html" href="../index.html">
    <link id="next-page" rel="Next" type="text/html"
href="../UsingTextClasses/UsingTextClasses.html">
    <link id="previous-page" rel="Prev" type="text/html" href="">
    <link rel="stylesheet" type="text/css"
href="../../../../../Resources/1282/CSS/screen.css">

    <!-- xcode_css -->
    <link rel="stylesheet" type="text/css"
href="../../../../../Resources/1282/CSS/feedback.css">
    <meta name="viewport" content="width=device-width, initial-scale=1,
maximum-scale=1">
    <meta id="platforms" name="platforms" content="iOS,tvOS">
</head>
<body class="" id=""><a name="//apple_ref/doc/uid/TP40009542-CH1"
title="About Text Handling in iOS"></a>
    <div id="_omniture_top">
    <!-- SiteCatalyst code version: H.8. Copyright 1997-2006 Omniture, Inc. -->
    <script type="text/javascript">
/* RSID: */
var s_account="appleglobal,appleusdeveloper,dappdeveloperlib"
</script>

    <script type="text/javascript"
src="https://www.apple.com/metrics/scripts/s_code_h.js"></script>
    <script type="text/javascript">
s.pageName=AC.Tracking.pageName();
s.channel="www.us.developer"

```

```

/***** DO NOT ALTER ANYTHING BELOW THIS LINE ! *****/
var s_code=s.t();if(s_code)document.write(s_code)</script>
<!-- End SiteCatalyst code version: H.8. -->
</div>

<div id="adcHeader" class="hideOnPrint hideInXcode">
  <div id="ssi_Header" class="hideInXcode unified">
    <a id="ssi_LibraryTitle"
href="https://developer.apple.com/library/archive/navigation/"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
navigation/_1&quot;;return this.s_oc?this.s_oc(e):true">Documentation
Archive</a>
    <a id="ssi_AppleDeveloperConnection"
href="https://developer.apple.com/"
onclick="s_objectID=&quot;https://developer.apple.com/_1&quot;;return
this.s_oc?this.s_oc(e):true">Developer</a>
    <div id="ssi_SearchButton" role="button" title="Search">Search</div>
  </div>
  <form id="ssi_SearchMenu" method="get" action="../../../search/"
accept-charset="utf-8">
    <label for="adcsearch">Search Documentation Archive</label>

    <input type="search" id="ssi_SearchField" name="q" accesskey="s"
results="5">
  </form>
</div>

<header id="header">
  <div id="title" role="banner">
    <h1>Text Programming Guide for iOS</h1>
    <span id="file_links">
      <a id="PDF_link" role="button" tabindex="4" rel="alternate"
title="Download PDF" class=""><span id="pdf_icon"></span>PDF</a>
      <a id="Companion_link" role="button" tabindex="3" title="Download
Companion File" class=""><span id="companion_icon"></span>Companion
File</a>
    </span>
  </div>
  <ul id="headerButtons" class="hideOnPrint" role="toolbar">
    <li id="toc_button" style="">
      <button tabindex="5" id="table_of_contents" class=""
role="checkbox" aria-label="Show Table of Contents"><span
class="disclosure"></span>Table of Contents</button>
    </li>
    <li id="jumpto_button" style="display:none" role="navigation"><select
tabindex="6" id="jumpTo"><option value="top">Jump
To...</option></select></li>
    <li id="downloadSample_button" style="display:none">
      <a id="Sample_link"><button id="Sample_button">Download Sample
Code</button></a>
    </li>

```

```

    </ul>
</header>
<nav id="tocContainer" tabindex="7" class="">
    <ul id="toc" role="tree"><li class=" "
data-aref="//apple_ref/doc/uid/TP40009542-CH1-SW1"><span
class="nodisclosure"></span><span class="sectionName"><a
href="/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebi
PhoneOS/Introduction/Introduction.html#//apple_ref/doc/uid/TP40009542-CH1-
SW1">Introduction</a></span></li><li class="children "
data-aref="//apple_ref/doc/uid/TP40009542-CH2-SW1" role="treeitem"><span
class="disclosure"></span><span class="sectionName"><a
href="/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebi
PhoneOS/UsingTextClasses/UsingTextClasses.html#//apple_ref/doc/uid/
TP40009542-CH2-SW1">Displaying Text Content in iOS</a></span><ul><li
class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH2-SW12"><span
class="nodisclosure"></span><span class="sectionName"><a
href="/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebi
PhoneOS/UsingTextClasses/UsingTextClasses.html#//apple_ref/doc/uid/
TP40009542-CH2-SW12">Use Text Objects to Display Text
Content</a></span></li><li class=" "
data-aref="//apple_ref/doc/uid/TP40009542-CH2-SW13"><span
class="nodisclosure"></span><span class="sectionName"><a
href="/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebi
PhoneOS/UsingTextClasses/UsingTextClasses.html#//apple_ref/doc/uid/
TP40009542-CH2-SW13">Use Web Views to Display Web
Content</a></span></li></ul></li><li class="children "
data-aref="//apple_ref/doc/uid/TP40009542-CH6-BBCFAEGE"
role="treeitem"><span class="disclosure"></span><span
class="sectionName"><a
href="/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebi
PhoneOS/TypoFeatures/TextSystemFeatures.html#//apple_ref/doc/uid/
TP40009542-CH6-BBCFAEGE">Typographical Concepts</a></span><ul><li
class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH6-64585"><span
class="nodisclosure"></span><span class="sectionName"><a
href="/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebi
PhoneOS/TypoFeatures/TextSystemFeatures.html#//apple_ref/doc/uid/
TP40009542-CH6-64585">Characters and Glyphs</a></span></li><li class=" "
data-aref="//apple_ref/doc/uid/TP40009542-CH6-50378"><span
class="nodisclosure"></span><span class="sectionName"><a
href="/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebi
PhoneOS/TypoFeatures/TextSystemFeatures.html#//apple_ref/doc/uid/
TP40009542-CH6-50378">Typefaces and Fonts</a></span></li><li class=" "
data-aref="//apple_ref/doc/uid/TP40009542-CH6-51627-BBCCCHIFF"><span
class="nodisclosure"></span><span class="sectionName"><a
href="/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebi
PhoneOS/TypoFeatures/TextSystemFeatures.html#//apple_ref/doc/uid/
TP40009542-CH6-51627-BBCCCHIFF">Text
Layout</a></span></li></ul></li><li class="children "
data-aref="//apple_ref/doc/uid/TP40009542-CH10-SW1" role="treeitem"><span
class="disclosure"></span><span class="sectionName"><a
href="/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebi
PhoneOS/ManageTextFieldTextViews/ManageTextFieldTextViews.html#//
apple_ref/doc/uid/TP40009542-CH10-SW1">Managing Text Fields and Text
Views</a></span><ul><li class=" "

```

[The Sequence of Messages to the Delegate](//apple_ref/doc/uid/TP40009542-CH10-SW15)

[Configuring Text Fields and Text Views](//apple_ref/doc/uid/TP40009542-CH10-SW16)

[Tracking Multiple Text Fields or Text Views](//apple_ref/doc/uid/TP40009542-CH10-SW17)

[Getting the Entered Text and Setting Text](//apple_ref/doc/uid/TP40009542-CH10-SW18)

[Using Formatters with Text Fields](//apple_ref/doc/uid/TP40009542-CH10-SW19)

[Validating Entered Text](//apple_ref/doc/uid/TP40009542-CH10-SW8)

[Using Overlay Views in Text Fields](//apple_ref/doc/uid/TP40009542-CH10-SW20)

[Tracking the Selection in Text Views](//apple_ref/doc/uid/TP40009542-CH10-SW21)

[Managing the Keyboard](//apple_ref/doc/uid/TP40009542-CH5-SW1)

role="treeitem">Keyboards and Input Methods<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH5-SW5">Configuring the Keyboard for Text Objects<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH5-SW12">Configuring the Keyboard for Web Views<li class="children " data-aref="//apple_ref/doc/uid/TP40009542-CH5-SW3" role="treeitem">Managing the Keyboard<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH5-SW16">Receiving Keyboard Notifications<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH5-SW18">Displaying the Keyboard<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH5-SW4">Dismissing the Keyboard<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH5-SW7">Moving Content That Is Located Under the Keyboard<li class="children " data-aref="//apple_ref/doc/uid/TP40009542-CH11-SW1" role="treeitem">Copy, Cut, and Paste Operations<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH11-SW27"><a href="/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebiPhoneOS/UsingCopy,Cut,andPasteOperations/

UsingCopy,Cut,andPasteOperations.html#//apple_ref/doc/uid/TP40009542-CH11-SW27">Copy-Paste Operations in UIKit<li class="children " data-aref="//apple_ref/doc/uid/TP40009542-CH11-SW21" role="treeitem">Pasteboard Concepts<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH11-SW28">Named Pasteboards<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH11-SW2">Pasteboard Persistence<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH11-SW30">Pasteboard Owner and Items<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH11-SW31">Representations and UTIs<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH11-SW33">Change Count<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH11-SW3">First Steps: Identify the Selection and Display the Edit Menu<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH11-SW22">Copying and Cutting the Selection<li class=" " data-aref="//apple_ref/doc/uid/TP40009542-CH11-SW37"><a

href="/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebi
PhoneOS/UsingCopy,Cut,andPasteOperations/
UsingCopy,Cut,andPasteOperations.html#//apple_ref/doc/uid/TP40009542-CH11-
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Menu

- [Dismissing the Edit Menu](#)
- [Using Text Kit to Draw and Manage Text](#)
 - [Primary Text Kit Objects](#)
 - [Text Attributes](#)
 - [Character Attributes](#)
 - [Paragraph Attributes](#)
 - [Document Attributes](#)
 - [Attribute Fixing](#)
 - [Changing Text Storage Programmatically](#)

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[Frequently Called UITextField Methods](/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebiPhoneOS/LowerLevelText-HandlingTechnologies/LowerLevelText-HandlingTechnologies.html#//apple_ref/doc/uid/TP40009542-CH15-SW35)

[Returning Rectangles](/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebiPhoneOS/LowerLevelText-HandlingTechnologies/LowerLevelText-HandlingTechnologies.html#//apple_ref/doc/uid/TP40009542-CH15-SW39)

[Hit Testing](/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebiPhoneOS/LowerLevelText-HandlingTechnologies/LowerLevelText-HandlingTechnologies.html#//apple_ref/doc/uid/TP40009542-CH15-SW42)

[Informing the Text Input Delegate of Changes](/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebiPhoneOS/LowerLevelText-HandlingTechnologies/LowerLevelText-HandlingTechnologies.html#//apple_ref/doc/uid/TP40009542-CH15-SW45)

[Spell Checking and Word Completion](/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebiPhoneOS/LowerLevelText-HandlingTechnologies/LowerLevelText-HandlingTechnologies.html#//apple_ref/doc/uid/TP40009542-CH15-SW47)

[Revision History](/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebiPhoneOS/RevisionHistory.html#//apple_ref/doc/uid/TP40009542-CH99-SW1)

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[CopyPasteTile](/library/archive/samplecode/CopyPasteTile/Introduction/Intro.html#//apple_ref/doc/uid/DTS40009040)

[SimpleTextInput](/library/archive/samplecode/SimpleTextInput/Introduction/Intro.html#//apple_ref/doc/uid/DTS40010633)

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<h1 id="pageTitle">About Text Handling in iOS</h1><p>The iOS platform gives you many ways to display text in your apps and let users edit that text. It also lets you display formatted text and web content in your app's views. The resources at your disposal range from <a data-renderer-version="1" target="_self" onclick="s_objectID="https://developer.apple.com/library/archive/documentation/General/Conceptual/DevPedia-CocoaCore/F_1";return this.s_oc?this.s_oc(e):true" data-href="../../../../../General/Conceptual/DevPedia-CocoaCore/Framework.html#//apple_ref/doc/uid/TP40008195-CH56">framework objects—such as text views, text fields, and web views—to text layout engines that you can use directly to draw, lay out, and otherwise manage text.</p><figure class="figure"></figure><p>With the classes in the UIKit framework, you can manage the edit menu (including adding custom items to it), implement custom input views, and copy, cut, and paste data within and between apps.</p><div

class="notebox"><aside><p>Note: This document was previously titled Text, Web, and Editing Programming Guide for iOS.</p><p></p></aside></div><h2 class="jump">At a Glance</h2><p>Apps in iOS have a number of powerful technologies to handle text, both for editing text and for rendering high-quality typographically formatted text.</p><section><h3>The UIKit Framework Provides Your App with Text and Web Objects</h3><p>You can add ready-made text views, text fields, and labels to your app's user interface by using instances of the <code>UIView</code>, <code>UITextField</code>, and <code>UILabel</code>. You can add and configure them programmatically or by using the <a data-renderer-version="1" target="_self" onclick="s_objectID="https://developer.apple.com/library/archive/documentation/General/Conceptual/DevPedia-CocoaCore/N_1";return this.s_oc?this.s_oc(e):true" data-href="../../../../../General/Conceptual/DevPedia-CocoaCore/NibFile.html#//apple_ref/doc/uid/TP40008195-CH34">Interface Builder editor in Xcode. You can also turn a view of your app into a miniature web browser capable of understanding and displaying HTML, CSS, and JavaScript content.</p><div class="notebox"><aside><p>Relevant Chapters: Displaying Text Content in iOS, Typographical Concepts, <a href="../ManageTextFieldTextViews/ManageTextFieldTextViews.html#//apple_ref/doc/uid/TP40009542-CH10-SW1" data-renderer-version="1" onclick="s_objectID="https://developer.apple.com/library/archive/

documentation/StringsTextFonts/Conceptual/TextAndWebi_5";return this.s_oc?this.s_oc(e):true">Managing Text Fields and Text Views</p><p></p></aside></div></section><section><h3>When Users Edit Text, Your App Must Manage the Keyboard</h3><p>When a user taps a text field, text view, or form field in a web view, iOS animates a keyboard into view. An app can control which keyboard is presented; for example, for a numeric-value field, the app should select the numeric keypad. If the entered or edited text is obscured by the keyboard, the app should adjust the view displaying the text so that the text appears above the keyboard. The <a data-renderer-version="1" target="_self" onclick="s_objectID="https://developer.apple.com/library/archive/documentation/General/Conceptual/DevPedia-CocoaCore/D_1";return this.s_oc?this.s_oc(e):true" data-href="../../../../../General/Conceptual/DevPedia-CocoaCore/Delegation.html#//apple_ref/doc/uid/TP40008195-CH14">delegate of a text view, text field, or web view is responsible for validating edited text and for accessing and storing edited text when the user dismisses the keyboard. </p><div class="notebox"><aside><p>Relevant Chapters: Managing the Keyboard</p><p></p></aside></div></section><section><h3>Your App Can Draw and Manage Text Directly</h3><p>Underlying the text views in UIKit is a powerful layout engine called Text Kit. If you need to customize the layout process or you need to intervene in that behavior, you can use Text Kit. Text Kit is a set of classes and protocols that provide high-quality typographical services which enable apps to store, lay out, and display text with all the characteristics of fine typesetting, such as kerning, ligatures, line breaking, and justification.</p><p>For most apps, you can use the high-level text display classes and Text Kit for all their text handling. For smaller amounts of text and special needs requiring custom solutions, you can use alternate, lower level technologies, such as the programmatic interfaces from the Core Text, Core Graphics, and Core Animation frameworks as well as other APIs in UIKit itself.</p><p>To communicate directly with the text-input system of iOS, implement the <code>UITextInput</code><a data-renderer-version="1" target="_self" onclick="s_objectID="https://developer.apple.com/library/archive/documentation/General/Conceptual/DevPedia-CocoaCore/P_1";return this.s_oc?this.s_oc(e):true" data-href="../../../../../General/Conceptual/DevPedia-

CocoaCore/Protocol.html#//apple_ref/doc/uid/TP40008195-CH45">protocol and related protocols and classes. Your app can also make use of technologies for spell checking and regular expressions.</p><div class="notebox"><aside><p>Relevant Chapter: Using Text Kit to Draw and Manage Text, Lower Level Text-Handling Technologies</p><p></p></aside></div><section><h3>Your App Has a Range of Options for the Input and Editing of Data</h3><p>The UIKit framework includes programmatic interfaces for editing the data in a view and for entering data into an app. Custom input views can replace the system keyboard to permit input of special data; input accessory views are a custom view above the system keyboard (or custom input view) that enables users to affect edited data in app-specific ways. Using <code>UIPasteboard</code> and related classes, an app can copy, cut, and paste data within different locations of itself or between itself and another app. As part of copy-cut-paste operations, the user taps a command on an contextual edit menu; your app manages this menu and can add custom commands to it.</p><div class="notebox"><aside><p>Relevant Chapters: Copy, Cut, and Paste Operations, Displaying and Managing the Edit Menu, <a href=" ../InputViews/InputViews.html#//apple_ref/doc/uid/TP40009542-CH12-SW1" data-renderer-version="1" onclick="s_objectID="https://developer.apple.com/library/archive/documentation/StringsTextFonts/Conceptual/TextAndWebi_11";return

this.s_oc?this.s_oc(e):true">Custom Views for Data Input</p><p></p></aside></div></section><div id="introSeeAlsoSection"><h2 class="jump">See Also</h2><p>The Core Graphics and Core Animation frameworks have some text-handling capabilities. Core Animation, for example, offers the <code>CATextLayer</code> class. To learn more about these capabilities, read Quartz 2D Programming Guide (Core Graphics) and Core Animation Programming Guide. </p><p>To find out more about the Core Text framework, which is appropriate for developing higher-level text-handling frameworks, read Core Text Programming Guide and Core Text Reference Collection. </p></div>

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Code</button></a>
  </li>
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</div>
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title="Technical Note TN2127"></a><div class="dtsDocNumber">Technical
Note TN2127</div><h1 id="pageTitle">Kernel Authorization</h1><div
class="importantbox
clear"><aside><p><strong>Important:</strong>&nbsp;  This document is no
longer being updated. For the latest information about Apple SDKs, visit the
<span class="content_text"><a
href="https://developer.apple.com/documentation" class="urlLink"
rel="external"
onclick="s_objectID=&quot;https://developer.apple.com/documentation_1&quot;
;return this.s_oc?this.s_oc(e):true">documentation
website</a></span>.</p><p></p></aside></div><p>Mac OS X 10.4 Tiger
introduced a new kernel subsystem, Kernel Authorization or Kauth for short, for
managing authorization within the kernel. The Kauth subsystem exports a kernel
programming interface (KPI) that allows third party kernel developers to
authorize actions within the kernel, modify authorization decisions, and extend
the kernel's authorization landscape. It can also be used as a notification
mechanism.</p><p>If you write code that interacts with the BSD portions of the
Mac OS X kernel, you should read this technote to gain a passing familiarity with
Kauth. If you need to perform any of the tasks list above, you'll want to study this
technote in depth. Finally, if you're developing an anti-virus product for Mac OS
X, you will need the information contained in this technote to implement "on
access" and "post modification" file scanning.</p>

```



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```
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```

```
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```

```
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```

```
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```

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```

```
</div>
```

```
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```

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```

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```

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this.s_oc?this.s_oc(e):true">File Operation Scope</a>
```

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this.s_oc?this.s_oc(e):true">Listener Gotchas

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<div class="nestedMiniTOC">

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this.s_oc?this.s_oc(e):true">Anti-Virus Scanner

</div>

<div>

[SUBSECTION20](#) New Kernel Subsystem

</div>

</div>

</div>

<div>

[KauthORama Sample Code](#)

</div>

<div>

[Document Revision History](#)

</div>

</div>

[Kauth Fundamentals](#)

Kauth Fundamentals

The Kauth system was introduced in Mac OS X 10.4 Tiger. It was implemented primarily to simplify the implementation of access control lists (ACLs), a major new feature of the Tiger kernel. Because evaluating an ACL is a complex task, the code for doing this has been abstracted out of each file system plug-in and moved into the kernel proper. Kauth does this in a

general and flexible way.

While Kauth was originally designed to support ACLs, it is a general kernel authorization mechanism and can be used for a variety of other tasks. One such use is as a simple notification mechanism for anti-virus developers (see [Anti-Virus Scanner](#)).

To understand Kauth, you'll need to understand a number of core concepts.

- scopes** — A scope is an area of interest for authorization within the kernel. For example, the scope `KAUTH_SCOPE_VNODE` is used for all authorization within the VFS layer. Scopes allow you to register interest in some subset of kernel authorization decisions, without being involved in all authorization decisions.

Scopes are strings formatted using reverse DNS notation (for example, `KAUTH_SCOPE_VNODE` is

`"com.apple.kauth.vnode"`), so you can define your own scope if you like.- actions** — An action is an operation within a scope. For example, the VFS subsystem defines an action, `KAUTH_VNODE_READ_DATA`, which determines whether you're allowed to read data from a file system object. Actions are specified by integer constants (the actual type is `kauth_action_t`) and each scope has its own action namespace.
- actors** — An actor is an entity that's performing an operation.

- credentials** — Credentials are the information that identifies an actor. Credentials are specified by an opaque type, `kauth_cred_t`. There are numerous accessor functions that let you operate on this type. For example, `kauth_cred_getuid` returns the effective user ID (EUID) from the credentials.
- request** — In the context of this document, an actor makes requests to perform an action within a particular scope.
- listener** — A listener is a callback that makes an authorization decision for a request. Fundamentally the listener authorizes the request based on the credentials of the actor. The listener is free to use whatever scope- and action-dependent information necessary to make that decision.
- There is a **default listener** for every built-in scope. This listener implements the standard BSD authorization model for all actions within that scope. In addition, you can register your own listeners for a scope.

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[Implementing a Listener](#)

The prototype for a listener is shown in [Listing 1](#).

[Listing 1Prototype for a listener](#)

Listing 1 Prototype for a listener

```
static int MyListener(
```

```
    kauth_cred_t credential,
    void * idata,
    kauth_action_t action,
    uintptr_t arg0,
    uintptr_t arg1,
```

```

    uintptr_t    arg2,
    uintptr_t    arg3
);
```

The meaning of the first three arguments is the same for all scopes.

- `credential` is a reference to the actor's credentials.

Important: When inspecting the credentials associated with a request, always use the accessor functions defined in `<sys/kauth.h>`. Be especially careful when testing for group membership. In Tiger a user can be in lots of groups (many more than the traditional limit of 16) and groups can be nested. If you want to test whether a user is a member of a group, use

```

kauth_cred_ismember_gid
```

- `idata` is the cookie (or refCon) data you supplied when you registered the listener (see `Registering a Listener`).
- `action` is the requested action (for example, `KAUTH_VNODE_READ_DATA`).

The meaning of the remaining parameters is scope dependent. I'll discuss these in detail in later sections. However, in most cases these parameters give you extra information that allow you to make an authorization decision. For example, for the VFS scope (`KAUTH_SCOPE_VNODE`), `arg1` is a reference to the vnode (of type `vnode_t`) that's being operated on.

A listener callback must return one of the following values.

- `KAUTH_RESULT_DEFER` — This value indicates that the listener defers the decision about this request to the other listeners (and ultimately to the default listener).
- `KAUTH_RESULT_ALLOW` — This value indicates that, as far as this listener is concerned, the request is allowed.
- `KAUTH_RESULT_DENY` — This value indicates that the request should be denied.

For a request to be allowed, at least one listener must return `KAUTH_RESULT_ALLOW` and no listeners can return `KAUTH_RESULT_DENY`. This has a number of consequences.

- All listeners are called for all requests (because the last listener just might return `KAUTH_RESULT_DENY`).
- Because a listener can't allow a request that's denied by any other listener, a non-default listener can only tighten security.

When writing a listener, there are a number of important points that you need to keep in mind. These are discussed in detail in `Listener Gotchas`.

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[Registering a Listener](//apple_ref/doc/uid/DTS10003591-CH1-SECTION3 "Registering a Listener")

Registering a Listener

You can register a listener for an existing scope using

```

kauth_listen_scope
```

[Listing 2kauth_listen_scope](//apple_ref/doc/uid/DTS10003591-CH1-SOURCECODE2 "Listing 2kauth_listen_scope")

Listing 2

```

kauth_listen_scope
```

```
clear"><table><tbody><tr><td scope="row"><pre>extern kauth_listener_t
kauth_listen_scope(    const char *        identifier,    kauth_scope_callback_t
callback,    void *        idata
);</pre></td></tr></tbody></table></div><p>The
parameters are as follows:</p><ul class="ul"><li
class="li"><p><code>identifier</code> is the name of the scope. The routine
does not make a copy of the string pointed to by this parameter. This is not a
problem if you're passing a constant string; however, if you're calculating the
string at runtime, you must make sure that the string persists until you dispose
of the resulting <code>kauth_listener_t</code>.</p></li><li
class="li"><p><code>callback</code> is the address of your listener callback
function, with the prototype shown in <span class="content_text"><!--a --
>Listing 1<!--/a--></span>.</p></li><li class="li"><p><code>idata</code>
is the cookie (or refCon) for your listener callback.</p></li></ul><p>On error,
the result is <code>NULL</code>. On success, the result is a reference to the
listener; you can use this to deregister your listener.</p><p>It is not an error to
register a listener before the corresponding scope is registered. The system will
remember your listener and apply it once the scope appears.</p><div
class="back_to_top"><a href="#top"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
technotes/tn2127/_index.html#top_3&quot;;return this.s_oc?
this.s_oc(e):true">Back to Top</a></div></section><section><a
name="//apple_ref/doc/uid/DTS10003591-CH1-SECTION4" title="Deregistering a
Listener"></a><h2 class="jump">Deregistering a Listener</h2><p>You can
deregister a listener using <code>kauth_unlisten_scope</code>.</p><a
name="//apple_ref/doc/uid/DTS10003591-CH1-SOURCECODE3" title="Listing
3kauth_unlisten_scope"></a><p class="codesample clear"><strong
class="caption_number">Listing
3</strong>&nbsp;&nbsp;&nbsp;kauth_unlisten_scope</p><div class="codesample
clear"><table><tbody><tr><td scope="row"><pre>extern void
kauth_unlisten_scope(kauth_listener_t
listener);</pre></td></tr></tbody></table></div><p>The
parameters are as follows:</p><ul class="ul"><li
class="li"><p><code>listener</code> is a reference to the listener you got
from <code>kauth_listen_scope</code>.</p></li></ul><div
class="importantbox clear"><aside><a
name="//apple_ref/doc/uid/DTS10003591-CH1-DontLinkElementID_4"
title="Important"></a><p><strong>Important:</strong>&nbsp;&nbsp;&nbsp;The return of
<code>kauth_unlisten_scope</code> does not guarantee that all threads
executing your listener have returned from your listener. Once
<code>kauth_unlisten_scope</code> returns, you must take steps to avoid
destroying state that these threads rely on until they've completed executing
your listener's code. See <span class="content_text"><!--a -->KauthORama
Sample Code<!--/a--></span> for an example of our recommended approach for
this.</p><p></p></aside></div><div class="back_to_top"><a href="#top"
onclick="s_objectID=&quot;https://developer.apple.com/library/archive/
technotes/tn2127/_index.html#top_4&quot;;return this.s_oc?
this.s_oc(e):true">Back to Top</a></div></section><section><a
name="//apple_ref/doc/uid/DTS10003591-CH1-SECTION5" title="Registering a
New Scope"></a><h2 class="jump">Registering a New Scope</h2><div
class="importantbox clear"><aside><a
name="//apple_ref/doc/uid/DTS10003591-CH1-DontLinkElementID_5"
title="Important"></a><p><strong>Important:</strong>&nbsp;&nbsp;&nbsp;You should
only do this if you want to create your own custom scope. In most cases third
```


party developers should register a listener for an existing scope.

You can register a new scope using `kauth_register_scope`.

[Listing 4kauth_register_scope](#)

Listing 4

```
extern kauth_scope_t
kauth_register_scope(    const char *        identifier,    kauth_scope_callback_t
callback,    void *        idata
);
```

The parameters are as follows:

- `identifier` is the name of the scope. It is an error to register a scope that already exists. The routine does not make a copy of the string pointed to by this parameter. This is not a problem if you're passing a constant string; however, if you're calculating the string at runtime, you must make sure that the string persists at least until you dispose of the resulting `kauth_scope_t`.
- `callback` is the address of the listener callback function for this scope; this becomes the scope's default listener. This parameter may be `NULL`, in which case a callback that always returns `KAUTH_RESULT_DEFER` is assumed.
- `idata` is the cookie (or refCon) for the listener callback.

On error, the result is `NULL`. On success, the result is a reference to the scope; you can use this to deregister your scope.

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[Deregistering a Scope](#)

You can deregister a scope using `kauth_deregister_scope`:

[Listing 5kauth_deregister_scope](#)

Listing 5

```
extern void
kauth_deregister_scope(kauth_scope_t
scope);
```

The parameters are as follows:

- `scope` is a reference to the scope you got from `kauth_register_scope`.

Any other (non-default) listeners registered on the scope will go dormant; they'll be reactivated if the scope is reregistered.

Important: The return of `kauth_deregister_scope` does not guarantee that all threads executing your listener have returned from your listener. See the discussion associated with `kauth_unlisten_scope` (in [Deregistering a Listener](#)) for details.

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[Deregistering a Listener](#)

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Authorizing an Action

You can make an authorization request using `kauth_authorize_action`.

Listing 6

```

kauth_authorize_action(
    kauth_scope_t scope,
    kauth_cred_t credential,
    kauth_action_t action,
    uintptr_t arg0,
    uintptr_t arg1,
    uintptr_t arg2,
    uintptr_t arg3
);

```

The parameters are as follows:

- `scope` is a reference to the scope in which the action is defined. You get this value from the result of `kauth_register_scope`.
- `credential` is a reference to the actor's credentials. Normally you would either already have this information, or you'd call `kauth_cred_get` to get the credentials for the current thread.
- `action` is the requested action.
- `arg0` through `arg3` are passed unmodified to the listener callbacks.

If your kernel extension supports plug-ins and those plug-ins call `kauth_authorize_action`, you must have a way for your plug-ins to discover the scope reference (`kauth_scope_t`). The easiest way to do this is to export a wrapper function that's tailored to your specific requirements.

Important: The kernel already provides `kauth_authorize_action` wrappers for all of the scopes that it defines. If you're authorizing within a kernel-defined scope you should call these wrappers rather than calling `kauth_authorize_action` directly. These wrappers are described below, along with corresponding scopes.

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Built-In Scopes

This section lists all of the scopes built in to the Mac OS X kernel.

Process Scope

The process scope (`KAUTH_SCOPE_PROCESS`, which is `"com.apple.kauth.process"`) is the easiest to understand. It defines just two actions.

- `KAUTH_PROCESS_CANTRACE` —

Authorizes whether the current process can trace the target process. `arg0` (of type `proc_t`) is the process being traced. `arg1` (of type `(int *)`) is a pointer to an errno-style error code; if the listener denies the request, it must set this value to a non-zero value.

`KAUTH_PROCESS_CANSIGNAL` — Authorizes whether the current process can signal the target process. `arg0` (of type `proc_t`) is the process to be signalled. `arg1` (of type `int`) is the signal that's being sent.

[Important: `KAUTH_PROCESS_CANSIGNAL` is currently not implemented by any version of Mac OS X \(r. \[rdar://problem/3931697\]\(#\)\)](#)

[Important: `KAUTH_PROCESS_CANSIGNAL` is currently not implemented by any version of Mac OS X \(r. \[rdar://problem/3931697\]\(#\)\)](#)

The kernel also exports a `kauth_authorize_action` wrapper for this scope, namely

`kauth_authorize_process`.

Listing 7
Listing 7

`kauth_authorize_process`

<pre>extern int</pre>

```
kauth_authorize_process(
    kauth_cred_t credential,
    kauth_action_t action,
    proc_t process,
    uintptr_t arg1,
    uintptr_t arg2,
    uintptr_t arg3
```

```
);
```

This wrapper around `kauth_authorize_action` does two useful things:

- It supplies the appropriate scope parameter.
- It eliminates the need to cast `process` (of type `proc_t`) to `arg0` (of type `uintptr_t`).

Typically this is not useful for third party developers.

[Generic Scope](#)

Generic Scope

The generic scope (`KAUTH_SCOPE_GENERIC`), which is

`"com.apple.kauth.generic"` has a single action, `KAUTH_GENERIC_ISSUSER`, which the kernel requests to test whether an actor has superuser privileges. None of the generic arguments (`arg0` through `arg3`) are significant.

[Important: The kernel does not currently use this request for all superuser tests; in many cases the kernel continues to directly compare the credential's effective user ID to 0.](#)

The kernel also exports a `kauth_authorize_action` wrapper for this scope, namely

```

<code>kauth_authorize_generic</code>.</p><a
name="//apple_ref/doc/uid/DTS10003591-CH1-SOURCECODE8" title="Listing
8kauth_authorize_generic"></a><p class="codesample clear"><strong
class="caption_number">Listing
8</strong>&nbsp;&nbsp;&nbsp;kauth_authorize_generic</p><div class="codesample
clear"><table><tbody><tr><td scope="row"><pre>extern int
kauth_authorize_generic(    kauth_cred_t    credential,    kauth_action_t
action
);<span></span></pre></td></tr></tbody></table></div><p>Typically this
is not useful for third party developers.</p></section><section><a
name="//apple_ref/doc/uid/DTS10003591-CH1-SUBSECTION10" title="File
Operation Scope"></a><h3 class="jump">File Operation Scope</h3><p>The
file operation scope (<code>KAUTH_SCOPE_FILEOP</code>, which is
<code>"com.apple.kauth.fileop"</code>) is different from other scopes in that
it's not used to actually authorize an operation; rather, the system uses this
scope to notify listeners of significant file system operations. This can be used to
implement an anti-virus scanning program, as described in <span
class="content_text"><!--a -->Anti-Virus
Scanner<!--/a--></span>.</p><p><code>KAUTH_SCOPE_FILEOP</code>
defines the following actions.</p><ul class="ul"><li
class="li"><p><code>KAUTH_FILEOP_OPEN</code> —&nbsp;&nbsp;&nbsp;Notifies that a file
system object (a file or directory) has been opened. <code>arg0</code> (of
type <code>vnode_t</code>) is a vnode reference. <code>arg1</code> (of
type <code>(const char *)</code>) is a pointer to the object's full
path.</p></li><li class="li"><p><code>KAUTH_FILEOP_CLOSE</code> —
Notifies that a file system object is about to be closed. <code>arg0</code> (of
type <code>vnode_t</code>) is a vnode reference. <code>arg1</code> (of
type <code>(const char *)</code>) is a pointer to the object's full path.
<code>arg2</code> (of type <code>int</code>) is a set of bit flags; the only
flag currently defined is <code>KAUTH_FILEOP_CLOSE_MODIFIED</code>, which
is set if a modified file is being closed.</p></li><li
class="li"><p><code>KAUTH_FILEOP_RENAME</code> —&nbsp;&nbsp;&nbsp;Notifies that a
file system object has been renamed. <code>arg0</code> (of type
<code>(const char *)</code>) is a pointer to the object's previous full path.
<code>arg1</code> (of type <code>(const char *)</code>) is a pointer to the
object's new full path.</p></li><li
class="li"><p><code>KAUTH_FILEOP_EXCHANGE</code> —&nbsp;&nbsp;&nbsp;Notifies that
two files have been exchanged (via <span class="content_text"><a href="x-
man-page://2/exchangedata" class="urlLink" rel="external"
onclick="s_objectID=&quot;x-man-page://2/exchangedata_1&quot;;return
this.s_oc?this.s_oc(e):true">exchangedata</a></span>). <code>arg0</code>
(of type <code>(const char *)</code>) is a pointer to the first file's full path.
<code>arg1</code> (of type <code>(const char *)</code>) is a pointer to the
second file's full path.</p></li><li
class="li"><p><code>KAUTH_FILEOP_LINK</code> —&nbsp;&nbsp;&nbsp;Notifies that a new
hard link has been added to a file (via the <span class="content_text"><a
href="x-man-page://2/link" class="urlLink" rel="external"
onclick="s_objectID=&quot;x-man-page://2/link_1&quot;;return this.s_oc?
this.s_oc(e):true">link</a></span> system call). <code>arg0</code> (of type
<code>(const char *)</code>) is a pointer to the full path of the original file.
<code>arg1</code> (of type <code>(const char *)</code>) is a pointer to the
full path of the newly created link.</p></li><li
class="li"><p><code>KAUTH_FILEOP_EXEC</code> —&nbsp;&nbsp;&nbsp;Notifies that a
program has been executed (via the <span class="content_text"><a href="x-

```

`man-page://2/execve`" class="urlLink" rel="external" onclick="s_objectID="x-man-page://2/execve_1";return this.s_oc?this.s_oc(e):true">execve system call). `<code>arg0</code>` (of type `<code>vnode_t</code>`) is a vnode reference of the program being executed (for Mach-O executables, this is the actual executable; for CFM applications, this will always reference `<code>LaunchCFMApp</code>`; for interpreted scripts, such as shell or perl scripts, this is the script, not the interpreter). `<code>arg1</code>` (of type `<code>(const char *)</code>`) is a pointer to the program file's full path.</p><p>If you install a listener in this scope, it will be called to notify you of these events. The kernel ignores the return value of your listener, although we recommend that you always return `<code>KAUTH_RESULT_DEFER</code>`.</p><div class="warningbox clear"><aside><p>Warning: Prior to Mac OS X 10.5 the file operation scope had a nasty gotcha

(r. `<code>arg0</code>` and `<code>arg1</code>` are `<code>NULL</code>` before accessing them as strings. Under certain circumstances (most notably, very early in the boot sequence and very late in the shutdown sequence), the kernel might pass you `<code>NULL</code>` for these arguments. If you access such a pointer as a string, you will kernel panic.</p><p></p><div class="clear"></div></aside></div><p>This problem was fixed in Mac OS X 10.5.</p><p>The kernel also exports a `<code>kauth_authorize_action</code>` wrapper for this scope, namely `<code>kauth_authorize_fileop</code>`.</p><p class="codesample clear"><strong class="caption_number">Listing 9 kauth_authorize_fileop</p><div class="codesample clear"><table><tbody><tr><td scope="row"><pre>extern int kauth_authorize_fileop(kauth_cred_t credential, kauth_action_t action, uintptr_t arg0, uintptr_t arg1);</pre></td></tr></tbody></table></div><p>Typically `<code>kauth_authorize_fileop</code>` is not useful for third party developers. However, if you do call it, take note of the following non-obvious behaviour. The `<code>arg0</code>` parameter of `<code>kauth_authorize_fileop</code>` is a `<code>vnode_t</code>`. `<code>kauth_authorize_fileop</code>` passes that `<code>vnode_t</code>` to the `<code>arg0</code>` parameter of the listener. It also gets the path to that vnode and passes that to the `<code>arg1</code>` parameter of the listener. Finally, for the `<code>KAUTH_FILEOP_CLOSE</code>` action, `<code>kauth_authorize_fileop</code>` passes its `<code>arg1</code>` parameter to the `<code>arg2</code>` parameter of the listener.</p></section><section><h3 class="jump">Vnode Scope</h3><p>The vnode scope (`<code>KAUTH_SCOPE_VNODE</code>`, which is `<code>"com.apple.kauth.vnode"</code>`) is the most complex scope currently defined. The first thing to note is that, within the vnode scope, actions are not enumerations but rather bitfields. Thus, it's perfectly reasonable to

combine actions by ORing them together. For example, an action of `KAUTH_VNODE_READ_DATA` | `KAUTH_VNODE_EXECUTE` indicates that actor wishes to both read and execute the file.

To authorize an action within the vnode scope, you would call `vnode_authorize`.

[Listing 10vnode_authorize](//apple_ref/doc/uid/DTS10003591-CH1-SOURCECODE10 "Listing 10vnode_authorize")

```
extern int
vnode_authorize( vnode_t vp, vnode_t dvp, kauth_action_t
action, vfs_context_t context
);
```

The parameters are as follows:

- `vp` is the vnode on which the action is being performed.
- `dvp` is the parent directory's vnode. In many cases this is `NULL`, indicating that the parent is unknown or irrelevant.
- `action` is the operation being performed; this is discussed in detail below.
- `context` is the VFS context associated with the actor. This is an opaque data structure that's intimately tied to the VFS implementation. Most VFS entry points are passed this context. In addition, there are numerous VFS context routines defined in `<sys/vnode.h>`.

`vnode_authorize` is a fairly simple wrapper around `kauth_authorize_action`. It performs two useful functions:

- It assembles the correct scope listener arguments (`arg0` through `arg3`). These are discussed below.
- It ensures that the error code is correct. Specifically, it translates the `EPERM` error returned by `kauth_authorize_action` into `EACCES` (which is the appropriate error for file system functions). Also, if the listener denies a request and provides a specific error code (via `arg3`, see below), it returns that error.

Important: It is relatively unusual for a VFS plug-in to call `vnode_authorize`. In most cases the VFS layer has authorized all actions before calling your plug-in. However, there are some circumstances where a VFS plug-in should call `vnode_authorize`. For example, HFS [Plus]'s implementation of `searchfs` uses `vnode_authorize` to ensure that the caller has access to the file system objects that it's returning.

The scope listener arguments for the vnode scope are as follows:

- `arg0`, of type `vfs_context_t`, is `context` — The VFS context, described above.
- `arg1`, of type `vnode_t`, is `vp` — The vnode itself.
- `arg2`, of type `vnode_t`, is

`dvp` — The parent vnode, if available. This may be `NULL`.

- `arg3`, of type `(int *)`, is `errPtr` — A pointer to an errno-style error. If your callback denies the request, it can set this value to indicate the error to return to the client. If you don't set this, the client gets `EACCES`.

Within the vnode scope, the following standard actions are defined.

- `KAUTH_VNODE_READ_DATA` (also `KAUTH_VNODE_LIST_DIRECTORY`) — If the vnode is a directory, authorizes the actor to enumerate the contents of that directory. Otherwise, authorizes the actor to read the contents of a file.
- `KAUTH_VNODE_WRITE_DATA` (also `KAUTH_VNODE_ADD_FILE`) — If the vnode is a directory, authorizes the actor to add a file to that directory. `vp` is the directory to which the file is being added; `dvp` is `NULL`. Otherwise, authorizes the actor to write the contents of a file.
- `KAUTH_VNODE_EXECUTE` (also `KAUTH_VNODE_SEARCH`) — If the vnode is a directory, authorizes the actor to probe for the existence of an item within the directory as part of a path lookup. Otherwise, authorizes the actor to execute the contents of a file.
- `KAUTH_VNODE_DELETE` — Authorizes the actor to delete an item from a directory. `vp` is the item to be deleted and `dvp` is the directory it's being deleted from.
- `KAUTH_VNODE_APPEND_DATA` (also `KAUTH_VNODE_ADD_SUBDIRECTORY`) — If the vnode is a directory, authorizes the actor to add a directory to it. Otherwise, this action is intended to authorize the actor to append data to the contents of a file; however, this aspect is not currently implemented.
- `KAUTH_VNODE_DELETE_CHILD` — When used in a directory's ACL, this permission controls whether the actor can delete an item from the directory. That is, for the actor to be able to delete the item, they must have `KAUTH_VNODE_DELETE` permission on the item and `KAUTH_VNODE_DELETE_CHILD` permission on the item's parent directory.

A Kauth listener, however, rarely sees this action. When an actor deletes an item, the kernel just authorizes the `KAUTH_VNODE_DELETE` action on the item itself; it does not authorize a separate `KAUTH_VNODE_DELETE_CHILD` action on the parent directory. Rather, the default listener for the vnode scope will check the `KAUTH_VNODE_DELETE_CHILD` permission on the parent directory directly, without another pass through Kauth. This improves performance and avoids a potential race condition.

On the other hand, a `KAUTH_VNODE_DELETE_CHILD` action is generated in response to an <x-man-page://2/access> `onclick="s_objectID="x-man-page://2/access_1";return this.s_oc?this.s_oc(e):true">access` system call with the `RMFILE_OK` flag.
- `KAUTH_VNODE_READ_ATTRIBUTES` — Authorizes the actor to read standard attributes of the vnode (such as the time stamps).
- `KAUTH_VNODE_WRITE_ATTRIBUTES` — Authorizes the actor to change standard attributes of the vnode (such as the time stamps).

- `KAUTH_VNODE_READ_EXTATTRIBUTES` — Authorizes the actor to read extended attributes of the vnode (those accessed via `getxattr`, including the resource fork).
- `KAUTH_VNODE_WRITE_EXTATTRIBUTES` — Authorizes the actor to change (or add) extended attributes of the vnode (those accessed via `getxattr`, including the resource fork).
- `KAUTH_VNODE_READ_SECURITY` — Authorizes the actor to read the vnode's ACL.
- `KAUTH_VNODE_WRITE_SECURITY` — Authorizes the actor to change the vnode's ACL.
- `KAUTH_VNODE_TAKE_OWNERSHIP` — Authorizes the actor to change ownership of the vnode.
- `KAUTH_VNODE_SYNCHRONIZE` — This represents an ACL permission that is defined for compatibility with other platforms. It is preserved but not tested by Mac OS X. Hence, it is never used as a Kauth action.
- `KAUTH_VNODE_LINKTARGET` — Authorizes the actor to make a new hard link to the vnode.
- `KAUTH_VNODE_CHECKIMMUTABLE` — Authorizes the actor to modify the file (in the `SF_IMMUTABLE` sense; see <x-man-page://2/chflags>). This flag is set if other checks have already been made to check that the file can be modified, but the modification should still fail for immutable files.
- `KAUTH_VNODE_ACCESS` — This is a special flag. If this flag is set the authorization request is advisory (for example, to satisfy an <x-man-page://2/access> system call) rather than authoritative. A listener can use this to avoid doing extra work in the advisory case.
- `KAUTH_VNODE_NOIMMUTABLE` — This is a special flag. It is passed to the listener along with the `KAUTH_VNODE_WRITE_SECURITY` bit (and no others) to indicate that the actor wishes to change one or more of the immutable flags, and that the state of these flags should not be considered when authorizing the request.

[Vnode Scope Gotchas](apple_ref/doc/uid/DTS10003591-CH1-SUBSUBSECTION11 "Vnode Scope Gotchas")

Remember that actions within the vnode scope are a bitfield. Thus a vnode scope listener can be called to authorize multiple actions simultaneously.

The vnode scope is **extremely hot**. If your vnode scope listener is slow, it will significantly slow down all file system operations. If you install a vnode scope listener, you should work to make it as efficient as possible.

When writing a vnode scope listener, be aware that not every file system operation will trigger an authorization request. For example, if an actor successfully requests `KAUTH_VNODE_SEARCH` on a directory, the system may cache that result and grant future requests without invoking your listener for each one.

For more information about the pitfalls of writing a listener, see [Listener Gotchas](#).

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onclick="s_objectID="https://developer.apple.com/library/archive/technotes/tn2127/_index.html#top_8";return this.s_oc?this.s_oc(e):true">Back to Top</div></section><section><h2 class="jump">Listener Gotchas</h2><p>When writing a listener, there are a number of important points that you need to keep in mind. These are discussed in the following sections.</p><section><h3 class="jump">Context</h3><p>In most cases your listener will be called by the user's thread. That is, a user thread has made a system call, which caused it to enter the kernel to do the work, which has triggered a Kauth request. So, it's possible to get information about the actor based on the current thread or process. For example, you can call `proc_self` to get a reference to the current process and then extract useful information from that.</p><p>However, you should try to avoid doing this. Rather, your listener should make its decision based on the actor's credentials (as passed to it in the `credentials` parameter) and, if you're listening in the <!--a -->vnode scope<!--/a-->, the VFS context.</p><p>There are two reasons for this recommendation.</p><ul class="ul"><li class="li"><p>As far as the overall kernel design is concerned, it is cleaner for your listener to make decisions based on its input parameters, rather than on implicit parameters like the current thread.</p><li class="li"><p>In some cases, it's possible for a kernel operation to be executed by another thread on behalf of the user. This sort of thing already happens for asynchronous I/O, where the kernel maintains a pool of async I/O threads that perform asynchronous file system requests. Currently these threads don't actually make authorization requests, but the long-term direction is clear.</p><section><h4 class="jump">Deadlock Avoidance</h4><p>Your listener is called by the thread that's performing the operation, so it's possible to block the thread while you process the request. However, this is a two-edged sword. It allows your listener to pass the request to an external agent (a user space daemon, for example) and block waiting for the results. However, doing so entails significant risk of deadlocking the system.</p><p>This problem most commonly crops up when writing a listener for the <!--a -->vnode<!--/a--> or <!--a -->file operation<!--/a--> scopes. A typical example is:</p><ol class="ol"><li class="li"><p>You install a listener for the <!--a -->file operation<!--/a--> scope.</p><li class="li"><p>A normal process opens a file.</p><li class="li"><p>Your listener is called with `KAUTH_FILEOP_OPEN`. It passes the request to a user space daemon and waits for the result.</p><li class="li"><p>The user space daemon calls some system routine that RPCs to a system daemon. For example, it might call getpwuid, which is actually implemented inside lookupd.</p><li class="li"><p>The system daemon opens a file.</p><li class="li"><p>This causes the kernel

to call your listener, and the cycle starts over again.

- System daemons call other system daemons. For example, `lookupd` is dependent on [DirectoryService](x-man-page://8/DirectoryService), which may in turn be dependent on other daemons.
- You can't just hard-code a list of possible system daemons because the dependency tree varies of from release-to-release; Apple can add new dependencies at any time.
- It's impossible for your daemon to not depend on any system daemons. Every time you touch pageable memory, you might trigger the allocation of a paging file, which depends on the [dynamic_pager](x-man-page://8/dynamic_pager).

There are a variety of ways to avoid this deadlock. The best is for your listener to avoid do any processing if the request comes from a thread running as root (that is, where `kauth_cred_getuid` for the actor's credentials returns 0). As all critical system daemons will necessarily run as root, you break the deadlock at step 6 above.

Note: The group resolution membership daemon, [memberd](x-man-page://8/memberd), faces a similar problem, and it avoids this problem in exactly this fashion; the system never invokes `memberd` if the thread is running as root.

However, this technique may not be appropriate in all cases. For example, an `anti-virus scanner` would particularly want to scan files being opened by a thread running with elevated privileges. In this case the only correct solution is for the scanner to operate entirely within the kernel.

Performance

Some Kauth scopes are very hot. That is, a typical system will make authorization requests in that scope frequently. For example, a system copying files might make thousands of `vnode scope` authorization requests per second. If you register a listener for a scope, it can be called for every request. If your listener is slow, it will significantly degrade system performance.

The two hot scopes on Mac OS X are the `vnode scope` and the `file operation scope`. If you install a listener for either of these scopes, be sure to measure the effect your listener has on overall system performance, and optimize your listener accordingly.

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Kauth


```

    }
    break;
default:
    // do nothing
    break;
}

```

```

return result;

```

```

} <span></span></pre></td></tr></tbody></table></div><div
class="notebox"><aside><a name="//apple_ref/doc/uid/DTS10003591-CH1-
DontLinkElementID_13"
title="Note"></a><p><strong>Note:</strong>&nbsp;Kauth is not invoked
when a program is started by the debugger. You can detect this case using the
technique shown in <span class="content_text"><a
href="/qa/qa2004/qa1361.html" class="urlLink" rel="external"
onclick="s_objectID=&quot;https://developer.apple.com/qa/qa2004/qa1361.html
_1&quot;;return this.s_oc?this.s_oc(e):true">Technical Q&A QA1361,
'Detecting the
Debugger'</a></span>.</p><p></p></aside></div></section><section><a
name="//apple_ref/doc/uid/DTS10003591-CH1-SUBSECTION19" title="Anti-Virus
Scanner"></a><h3 class="jump">Anti-Virus Scanner</h3><p>Kauth allows
you to implement an anti-virus program that supports both "on access" and "post
modification" file scanning. The latter is easy: all you need to do is register a
listener for the <code>KAUTH_SCOPE_FILEOP</code> scope and watch for the
<code>KAUTH_FILEOP_CLOSE</code> action. If you see a modified file being
closed, you can pass that file to your user space daemon for scanning. As the
scanning proceeds asynchronously in the background, there should be no
problems with deadlock.</p><p>Implementing "on access" scanning is more
challenging. Your approach depends on whether you can always fix a file. If
that's the case, you can listen for <code>KAUTH_FILEOP_OPEN</code> (in the
<code>KAUTH_SCOPE_FILEOP</code>) and scan the file immediately after it's
been opened. However, the result of your listener is always ignored, so there is
no way to deny the actor access to that file.</p><p>If you can't always fix a file,
and thus you may want to deny the actor access to the file, you must listen for
the appropriate actions in the <code>KAUTH_SCOPE_VNODE</code> scope. If
you scan a file, detect that it's infected, and can't fix it, you should return
<code>KAUTH_RESULT_DENY</code> to prevent the actor from using
it.</p><p>The difficulty with both of these "on access" approaches is avoiding
deadlock. See <span class="content_text"><!--a -->Implementing a
Listener<!--/a--></span> for a detailed discussion of this
problem.</p></section><section><a
name="//apple_ref/doc/uid/DTS10003591-CH1-SUBSECTION20" title="New
Kernel Subsystem"></a><h3 class="jump">New Kernel Subsystem</h3><p>If
you're implementing an entirely new kernel subsystem (for example, a
sophisticated protocol stack), you may decide to implement your authorization
using Kauth. There are seven steps to this:</p><ol class="ol"><li
class="li"><p>Decide on a scope name. You should use a reverse DNS-style
name, as illustrated by the built-in scopes <span class="content_text"><!--a --
>described in this document<!--/a--></span>.</p></li><li
class="li"><p>Decide on a set of actions. You can choose to use either an
enumeration (as done by the <span class="content_text"><!--a -->file
operations scope<!--/a--></span>) or a bitmask (as used by the <span
class="content_text"><!--a -->vnode scope<!--/a--></span>).</p></li><li
class="li"><p>For each action, you must decide what request-specific

```

arguments (of type `arg0` through `arg3`) are appropriate for that action. It's easiest if the arguments are the same for all of the actions within your scope, but that's not required.

- Write a default listener for your scope. This listener should be able to make authorization decisions based on:

 - the identity of the actor (as represented by the listener's `credentials` parameter)
 - the requested action
 - the request-specific arguments

Your listener can extract information from the credentials using the accessor functions defined in `sys/kauth.h`.
- Create your scope, and register your listener as the default listener, using `kauth_register_scope`.
- Create a scope-specific wrapper function for `kauth_authorize_action` that:

 - supplies a reference to the scope created in the previous step
 - casts your scope-specific arguments to the generic arguments (`arg0` through `arg3`) used by `kauth_authorize_action`
- Call your scope-specific wrapper function to authorize specific actions at appropriate places in your kernel subsystem.

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[KauthORama Sample Code](/samplecode/KauthORama/index.html) is a great tool for exploring Kauth. It allows you to register a dummy listener for any scope. The listener always returns `KAUTH_RESULT_DEFER`, and so has no effect on authorization decisions, but it prints a record of the authorization request. Using this you can see how Kauth interacts with high-level operations, like listing directories or copying files. The sample's read me file has instructions for doing this.

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[Document Revision History](/apple_ref/doc/uid/DTS10003591-CH1-DontLinkElementID_1)

[Document Revision History](/apple_ref/doc/uid/DTS10003591-RevisionHistory-DontLinkElementID_1)

Date	Notes
2010-03-23	A minor update to address some points of confusion. Firstly, <code>KAUTH_PROCESS_CANSIGNAL</code> is not implemented on any version of Mac OS X, not just Mac OS X 10.4 (r. 7724502). Secondly, the behaviour of

kauth_authorize_fileop is non-obvious and this update clarifies its behavior (r. 5777071). Finally, there were some minor changes to account for the very small differences in Kauth since Mac OS X 10.4.

2007-01-16	Document a kernel bug that causes certain arguments to be NULL.
2006-03-21	Corrected problems with non-ASCII characters.
2005-06-03	New document that describes the kernel authorization (kauth) subsystem and its associated KPI.

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%20Notes">Release Notes</a></li><li id="navigation_5" class="group" data-
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href="#section=Resource%20Types&topic=Sample%20Code">Sample
Code</a></li><li id="navigation_2" class="group" data-topic="1" '=""><a
onclick="Doc.filterTopic(event);return false" href="#section=Resource
%20Types&topic=Technical%20Notes">Technical Notes</a></li><li
id="navigation_6" class="group" data-topic="1" '=""><a
onclick="Doc.filterTopic(event);return false" href="#section=Resource
%20Types&topic=Technical%20Q%26amp%3BAs">Technical
Q&As</a></li><li id="navigation_15" class="group" data-topic="1"
'=""><a onclick="Doc.filterTopic(event);return false" href="#section=Resource
%20Types&topic=Xcode%20Tasks">Xcode Tasks</a></li></ul><li
id="navigation_topic_2" class="navigationTopics title"
onclick="Navigation.toggleSection(this)" data-topic="2"><span
class="disclosure "></span><a onclick="Doc.filterTopic(event);return false"
href="#section=Topics">Topics</a></li><ul id="Topic_Topics"
class="navigation_Topic "><li id="navigation_200" class="group" data-
topic="2" '=""><a onclick="Doc.filterTopic(event);return false"
href="#section=Topics&topic=Apple%20Applications">Apple
Applications</a></li><li id="navigation_260" class="group" data-topic="2"
'=""><a onclick="Doc.filterTopic(event);return false"
href="#section=Topics&topic=Audio%2C%20Video%2C%20%26amp%3B
%20Visual%20Effects">Audio, Video, & Visual Effects</a></li><li
id="navigation_800" class="group" data-topic="2" '=""><a
onclick="Doc.filterTopic(event);return false"
href="#section=Topics&topic=Cross%20Platform">Cross
Platform</a></li><li id="navigation_850" class="group selected" data-
topic="2" '=""><a onclick="Doc.filterTopic(event);return false"
href="#section=Topics&topic=Data%20Management">Data
Management</a></li><li id="navigation_1030" class="group" data-topic="2"
'=""><a onclick="Doc.filterTopic(event);return false"
href="#section=Topics&topic=Drivers%2C%20Kernel%2C%20%26amp%3B
%20Hardware">Drivers, Kernel, & Hardware</a></li><li id="navigation_1"
class="group" data-topic="2" '=""><a onclick="Doc.filterTopic(event);return
false" href="#section=Topics&topic=General">General</a></li><li
id="navigation_1220" class="group" data-topic="2" '=""><a
onclick="Doc.filterTopic(event);return false"
href="#section=Topics&topic=Graphics%20%26amp%3B
%20Animation">Graphics & Animation</a></li><li id="navigation_1360"
class="group" data-topic="2" '=""><a onclick="Doc.filterTopic(event);return
false" href="#section=Topics&topic=Interapplication
%20Communication">Interapplication Communication</a></li><li
id="navigation_1460" class="group" data-topic="2" '=""><a
onclick="Doc.filterTopic(event);return false"
href="#section=Topics&topic=Languages%20%26amp%3B
```


%20Utilities">Languages & Utilities<li id="navigation_1520" class="group" data-topic="2" '="">Mathematical Computation<li id="navigation_1670" class="group" data-topic="2" '="">Networking, Internet, & Web<li id="navigation_1770" class="group" data-topic="2" '="">Performance<li id="navigation_2060" class="group" data-topic="2" '="">Security<li id="navigation_2265" class="group" data-topic="2" '="">Swift<li id="navigation_2320" class="group" data-topic="2" '="">System Administration<li id="navigation_2450" class="group" data-topic="2" '="">User Experience<li id="navigation_2600" class="group" data-topic="2" '="">Xcode<li id="navigation_topic_3" class="navigationTopics title" onclick="Navigation.toggleSection(this)" data-topic="3">Technologies<li id="Topic_Technologies" class="navigation_Topic "><li id="navigation_470" class="group" data-topic="3" onclick="Navigation.toggleSection(this)">Cocoa Layer<ul id="Topic_0" class="navigation_SubTopic "><li id="navigation_subtopic_120" onclick="Doc.filterTopic(event)" data-topic="3">AddressBookUI<li id="navigation_subtopic_190" onclick="Doc.filterTopic(event)" data-topic="3">AppKit<li id="navigation_subtopic_555" onclick="Doc.filterTopic(event)" data-topic="3">ContactsUI<li id="navigation_subtopic_1350" onclick="Doc.filterTopic(event)" data-topic="3">Intents<li id="navigation_subtopic_1510" onclick="Doc.filterTopic(event)" data-topic="3">MapKit<li id="navigation_subtopic_1600" onclick="Doc.filterTopic(event)" data-topic="3">MessageUI<li id="navigation_subtopic_1595" onclick="Doc.filterTopic(event)" data-topic="3">Messages<li id="navigation_subtopic_1995" onclick="Doc.filterTopic(event)" data-topic="3">ReplayKit<li id="navigation_subtopic_2020" onclick="Doc.filterTopic(event)" data-topic="3">ScreenSaver<li id="navigation_subtopic_2130" onclick="Doc.filterTopic(event)" data-topic="3">SecurityInterface<li id="navigation_subtopic_2345" onclick="Doc.filterTopic(event)" data-topic="3">TVMLKit<li id="navigation_subtopic_2406" onclick="Doc.filterTopic(event)" data-topic="3">Twitter<li id="navigation_subtopic_2420" onclick="Doc.filterTopic(event)" data-

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```

href="#section=Frameworks&topic=Kernel%20%26amp%3B%20Driver
%20Layer">Kernel & Driver Layer</a></li><ul id="Topic_111"
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id="navigation_subtopic_1380" onclick="Doc.filterTopic(event)" data-
topic="3">IOKit</li><li id="navigation_subtopic_1300"
onclick="Doc.filterTopic(event)" data-topic="3">ImageCaptureCore</li><li
id="navigation_subtopic_1430" onclick="Doc.filterTopic(event)" data-
topic="3">Kernel</li></ul></ul></ul>
</div>
<div id="mainContent">

```

```

    <div id="contentBox" class="show">
        <div id="currentFilter_Callout">
            <div id="currentFilter_GettingStartedList" class=""></div>
        </div>
        <h2 id="currentFilter_Title">Data Management</h2>
        <p id="currentFilter_Description" class="visible">

```

```

<meta name="ROBOTS" content="NOINDEX, NOFOLLOW">
<title>Data Management</title>
<meta id="xcode-display" name="xcode-display" content="render">
<meta http-equiv="content-type" content="text/html; charset=utf-8">
<script>
    function listen(elem, evnt, func) {
        if (elem.addEventListener){
            elem.addEventListener(evnt,func,false);
        } else if (elem.attachEvent) {
            var r = elem.attachEvent("on"+evnt, func);
            return r;
        }
    }
    listen(window, 'load', function(evt){
        window.location.href = "../index.html#section=Topics&topic=Data
%20Management";
    });
</script>

```

[Create and handle OS X program data, including strings, text, binary data, dates, collections, property lists, and XML data. Store and access data in local databases, files, folders, and bundles. Receive and respond appropriately to events, notifications, and other types of messages.](https://apple_ref/doc/uid/TP40007359 "Data Management")

```

</p>
</div>
<div id="frontPageTabContainer" class="hide">
    <div id="frontPageTabContents">
        <a href="https://developer.apple.com/documentation">
            <div class="osx-bg"></div>
        </a>
    </div>

```

```

</div>
<div id="documentsBox" class="RefLib">
  <div id="docTableFilter">
    <span id="docTableFilter_title">Documents</span>
    <div id="docsFound">331 of 5219</div>
    <input type="search" class="prettysearch" placeholder=""
name="documentFilter" id="documentFilter" results="0" autosave="">
  </div>
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id="platforms" style="display:none;"><span
class="sortArrow"></span>Platform</th><th id="type" class="types"><span
class="sortArrow"></span>Resource Type</th><th id="topic"
class="topics"><span class="sortArrow"></span>Topic</th><th
id="technology" class="technologies"><span
class="sortArrow"></span>Technology</th><th id="date"
class="revisionDates sortedOn-1"><span
class="sortArrow"></span>Date</th></thead><tbody><tr
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onclick="Details.toggle('TP40016999')">&nbsp;</div><div class="docTitle"><a
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Introduction.html#//apple_ref/doc/uid/TP40016999">Apple File System
Guide</a></div><div id="docID_TP40016999_details"
class="docDetails"></div></td><td style="display:none;">watchOS|tvOS|iOS|
macOS</td><td class="resourceTypes">Guides</td><td class="topics">Data
Management<div class="subtopics">File Management</div></td><td
class="technologies"></td><td class="revisionDateandSize"><div
class="docRevisionDate">2018-06-04</div><div
class="docRevisionSize">Content Update</div><div
class="docDependencyName"></div></td></tr><tr
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references in CFPreferences</a></div><div id="docID_DTS10003323_details"
class="docDetails"></div></td><td style="display:none;">macOS</td><td
class="resourceTypes">Technical Q&A</td><td class="topics">Data
Management<div class="subtopics">File Management</div></td><td
class="technologies">CoreFoundation</td><td
class="revisionDateandSize"><div
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class="docRevisionSize">Minor Change</div><div
class="docDependencyName"></div></td></tr><tr
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onclick="Details.toggle('TP40017387')">&nbsp;</div><div class="docTitle"><a
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href="..documentation/Miscellaneous/Reference/MobileDeviceManagementProto
colRef/1-Introduction/Introduction.html#//apple_ref/doc/uid/TP40017387">Mobile
Device Management Protocol Reference</a></div><div

```

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class="revisionDateandSize"><div
class="docRevisionDate">2003-07-28</div><div class="docRevisionSize">First
Version</div><div class="docDependencyName"></div></td></tr><tr
id="docID_TP40000959"><td class="docTitleAndDescription"><div
class="detailDisclosure"
onclick="Details.toggle('TP40000959')">&nbsp;</div><div class="docTitle"><a
id="docID_TP40000959_Link"
href=" ../documentation/Carbon/Conceptual/using_ink/ink_intro/ink_intro.html#//
apple_ref/doc/uid/TP40000959">Using Ink Services in Your
Application</a></div><div id="docID_TP40000959_details"
class="docDetails"></div></td><td style="display:none;">macOS</td><td
class="resourceTypes">Guides</td><td class="topics">Data Management<div
class="subtopics">Event Handling</div></td><td
class="technologies">Foundation</td><td class="revisionDateandSize"><div
class="docRevisionDate">2003-07-24</div><div
class="docRevisionSize">Content Update</div><div
class="docDependencyName"></div></td></tr><tr
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id="docID_DTS10000467"><td class="docTitleAndDescription"><div class="detailDisclosure" onclick="Details.toggle('DTS10000467')"> </div><div class="docTitle">DeviceListener</div><div id="docID_DTS10000467_details" class="docDetails"></div></td><td style="display:none;">macOS</td><td class="resourceTypes">Sample Code</td><td class="topics">Data Management<div class="subtopics">File Management</div></td><td class="technologies">CoreServices</td><td class="revisionDateandSize"><div class="docRevisionDate">2003-07-17</div><div class="docRevisionSize">First Version</div><div class="docDependencyName"></div></td></tr><tr id="docID_DTS10003096"><td class="docTitleAndDescription"><div class="detailDisclosure" onclick="Details.toggle('DTS10003096')"> </div><div class="docTitle">Glyph Access Protocol</div><div id="docID_DTS10003096_details" class="docDetails"></div></td><td style="display:none;">macOS</td><td class="resourceTypes">Technical Notes</td><td class="topics">Data Management<div class="subtopics">Strings, Text, & Fonts</div></td><td class="technologies">AppKit</td><td class="revisionDateandSize"><div class="docRevisionDate">2003-05-06</div><div class="docRevisionSize">First Version</div><div class="docDependencyName"></div></td></tr><tr id="docID_DTS10000741"><td class="docTitleAndDescription"><div class="detailDisclosure" onclick="Details.toggle('DTS10000741')"> </div><div class="docTitle">PIDFromBSDProcessName</div><div id="docID_DTS10000741_details" class="docDetails"></div></td><td style="display:none;">macOS</td><td class="resourceTypes">Sample Code</td><td class="topics">Data Management<div class="subtopics">Event Handling</div></td><td class="technologies"></td><td class="revisionDateandSize"><div class="docRevisionDate">2003-02-13</div><div class="docRevisionSize">First Version</div><div class="docDependencyName"></div></td></tr><tr id="docID_DTS10000476"><td class="docTitleAndDescription"><div class="detailDisclosure" onclick="Details.toggle('DTS10000476')"> </div><div class="docTitle">resolveRelativeAlias</div><div id="docID_DTS10000476_details" class="docDetails"></div></td><td style="display:none;">macOS</td><td class="resourceTypes">Sample Code</td><td class="topics">Data Management<div class="subtopics">File Management</div></td><td class="technologies">CoreServices</td><td class="revisionDateandSize"><div class="docRevisionDate">2003-01-14</div><div class="docRevisionSize">First Version</div><div class="docDependencyName"></div></td></tr><tr id="docID_DTS10000410"><td class="docTitleAndDescription"><div class="detailDisclosure" onclick="Details.toggle('DTS10000410')"> </div><div

```
class="docTitle"><a id="docID_DTS10000410_Link"
href="../samplecode/TextViewConfig/Introduction/Intro.html#//apple_ref/doc/
uid/DTS10000410">TextViewConfig</a></div><div
id="docID_DTS10000410_details" class="docDetails"></div></td><td
style="display:none;">macOS</td><td class="resourceTypes">Sample
Code</td><td class="topics">Data Management<div
class="subtopics">Strings, Text, & Font</div></td><td
class="technologies">AppKit</td><td class="revisionDateandSize"><div
class="docRevisionDate">2003-01-14</div><div class="docRevisionSize">First
Version</div><div class="docDependencyName"></div></td></tr><tr
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onclick="Details.toggle('DTS10000727')">&nbsp;</div><div
class="docTitle"><a id="docID_DTS10000727_Link"
href="../samplecode/SpellingChecker-CarbonCocoa/Introduction/Intro.html#//
apple_ref/doc/uid/DTS10000727">SpellingChecker-CarbonCocoa</a></
div><div id="docID_DTS10000727_details"
class="docDetails"></div></td><td style="display:none;">macOS</td><td
class="resourceTypes">Sample Code</td><td class="topics">Data
Management<div class="subtopics">Strings, Text, & Font</div></td><td
class="technologies">AppKit</td><td class="revisionDateandSize"><div
class="docRevisionDate">2003-01-14</div><div class="docRevisionSize">First
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class="detailDisclosure"
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class="docTitle"><a id="docID_DTS10000473_Link"
href="../samplecode/MoreFiles/Introduction/Intro.html#//apple_ref/doc/uid/
DTS10000473">MoreFiles</a></div><div id="docID_DTS10000473_details"
class="docDetails"></div></td><td style="display:none;">macOS</td><td
class="resourceTypes">Sample Code</td><td class="topics">Data
Management<div class="subtopics">File Management</div></td><td
class="technologies">CoreServices</td><td class="revisionDateandSize"><div
class="docRevisionDate">2003-01-14</div><div class="docRevisionSize">First
Version</div><div class="docDependencyName"></div></td></tr><tr
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onclick="Details.toggle('DTS10000469')">&nbsp;</div><div
class="docTitle"><a id="docID_DTS10000469_Link"
href="../samplecode/Eraser/Introduction/Intro.html#//apple_ref/doc/uid/
DTS10000469">Eraser</a></div><div id="docID_DTS10000469_details"
class="docDetails"></div></td><td style="display:none;">macOS</td><td
class="resourceTypes">Sample Code</td><td class="topics">Data
Management<div class="subtopics">File Management</div></td><td
class="technologies">CoreServices</td><td class="revisionDateandSize"><div
class="docRevisionDate">2003-01-14</div><div class="docRevisionSize">First
Version</div><div class="docDependencyName"></div></td></tr><tr
id="docID_DTS10000468"><td class="docTitleAndDescription"><div
class="detailDisclosure"
onclick="Details.toggle('DTS10000468')">&nbsp;</div><div
class="docTitle"><a id="docID_DTS10000468_Link"
href="../samplecode/EnhancedDataBurn/Introduction/Intro.html#//apple_ref/
doc/uid/DTS10000468">EnhancedDataBurn</a></div><div
id="docID_DTS10000468_details" class="docDetails"></div></td><td
```

style="display:none;">macOS</td><td class="resourceTypes">Sample Code</td><td class="topics">Data Management<div class="subtopics">File Management</div></td><td class="technologies">CoreServices</td><td class="revisionDateandSize"><div class="docRevisionDate">2003-01-14</div><div class="docRevisionSize">First Version</div><div class="docDependencyName"></div></td></tr><tr id="docID_DTS10000723"><td class="docTitleAndDescription"><div class="detailDisclosure" onclick="Details.toggle('DTS10000723')"> </div><div class="docTitle">CFPrefsDumper</div><div id="docID_DTS10000723_details" class="docDetails"></div></td><td style="display:none;">macOS</td><td class="resourceTypes">Sample Code</td><td class="topics">Data Management<div class="subtopics">Preference Settings</div></td><td class="technologies">CoreFoundation</td><td class="revisionDateandSize"><div class="docRevisionDate">2003-01-14</div><div class="docRevisionSize">First Version</div><div class="docDependencyName"></div></td></tr><tr id="docID_DTS10000662"><td class="docTitleAndDescription"><div class="detailDisclosure" onclick="Details.toggle('DTS10000662')"> </div><div class="docTitle">BasicInputMethod</div><div id="docID_DTS10000662_details" class="docDetails"></div></td><td style="display:none;">macOS</td><td class="resourceTypes">Sample Code</td><td class="topics">Data Management<div class="subtopics">Event Handling</div></td><td class="technologies">InputMethodKit</td><td class="revisionDateandSize"><div class="docRevisionDate">2003-01-14</div><div class="docRevisionSize">First Version</div><div class="docDependencyName"></div></td></tr><tr id="docID_DTS10003072"><td class="docTitleAndDescription"><div class="detailDisclosure" onclick="Details.toggle('DTS10003072')"> </div><div class="docTitle">Exclusive File Access in Mac OS X</div><div id="docID_DTS10003072_details" class="docDetails"></div></td><td style="display:none;">macOS</td><td class="resourceTypes">Technical Notes</td><td class="topics">Data Management<div class="subtopics">File Management</div></td><td class="technologies">CoreServices</td><td class="revisionDateandSize"><div class="docRevisionDate">2002-05-01</div><div class="docRevisionSize">First Version</div><div class="docDependencyName"></div></td></tr><tr id="docID_DTS10001607"><td class="docTitleAndDescription"><div class="detailDisclosure" onclick="Details.toggle('DTS10001607')"> </div><div class="docTitle">How do I use kMPCreateTaskSuspendedMask with MPCreateTask?</div><div id="docID_DTS10001607_details" class="docDetails"></div></td><td style="display:none;">macOS</td><td class="resourceTypes">Technical Q&A</td><td class="topics">Data Management<div

class="subtopics">Event Handling</div></td><td
class="technologies">CoreServices</td><td class="revisionDateandSize"><div
class="docRevisionDate">2001-07-02</div><div class="docRevisionSize">First
Version</div><div class="docDependencyName"></div></td></tr><tr
id="docID_DTS10003054"><td class="docTitleAndDescription"><div
class="detailDisclosure"
onclick="Details.toggle('DTS10003054')"> </div><div
class="docTitle"><a id="docID_DTS10003054_Link"
href=" ../technotes/tn/tn2015.html#//apple_ref/doc/uid/DTS10003054">Locating
Application Support Files under Mac OS X</div><div
id="docID_DTS10003054_details" class="docDetails"></div></td><td
style="display:none;">macOS</td><td class="resourceTypes">Technical
Notes</td><td class="topics">Data Management<div class="subtopics">File
Management</div></td><td class="technologies">CoreServices</td><td
class="revisionDateandSize"><div
class="docRevisionDate">2001-03-27</div><div class="docRevisionSize">First
Version</div><div class="docDependencyName"></div></td></tr><tr
id="docID_DTS10002442"><td class="docTitleAndDescription"><div
class="detailDisclosure"
onclick="Details.toggle('DTS10002442')"> </div><div
class="docTitle"><a id="docID_DTS10002442_Link"
href=" ../technotes/fl/fl_16.html#//apple_ref/doc/uid/DTS10002442">File Manager
Performance and Caching</div><div id="docID_DTS10002442_details"
class="docDetails"></div></td><td style="display:none;">macOS</td><td
class="resourceTypes">Technical Notes</td><td class="topics">Data
Management<div class="subtopics">File Management</div></td><td
class="technologies">CoreServices</td><td class="revisionDateandSize"><div
class="docRevisionDate">2000-09-01</div><div
class="docRevisionSize">Minor Change</div><div
class="docDependencyName"></div></td></tr><tr
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class="detailDisclosure"
onclick="Details.toggle('DTS10002466')"> </div><div
class="docTitle"><a id="docID_DTS10002466_Link"
href=" ../technotes/fl/fl_515.html#//apple_ref/doc/uid/DTS10002466">File
Manager File Handling Q&A</div><div
id="docID_DTS10002466_details" class="docDetails"></div></td><td
style="display:none;">macOS</td><td class="resourceTypes">Technical
Notes</td><td class="topics">Data Management<div class="subtopics">File
Management</div></td><td class="technologies">CoreServices</td><td
class="revisionDateandSize"><div
class="docRevisionDate">2000-08-14</div><div
class="docRevisionSize">Content Update</div><div
class="docDependencyName"></div></td></tr><tr
id="docID_DTS10001200"><td class="docTitleAndDescription"><div
class="detailDisclosure"
onclick="Details.toggle('DTS10001200')"> </div><div
class="docTitle"><a id="docID_DTS10001200_Link"
href=" ../qa/fl/fl14.html#//apple_ref/doc/uid/DTS10001200">Finding your
application's directory</div><div id="docID_DTS10001200_details"
class="docDetails"></div></td><td style="display:none;">macOS</td><td
class="resourceTypes">Technical Q&A</td><td class="topics">Data
Management<div class="subtopics">File Management</div></td><td
class="technologies">CoreServices</td><td class="revisionDateandSize"><div

```

class="docRevisionDate">2000-06-19</div><div class="docRevisionSize">First
Version</div><div class="docDependencyName"></div></td></tr><tr><tr
id="docID_DTS10001196"><td class="docTitleAndDescription"><div
class="detailDisclosure"
onclick="Details.toggle('DTS10001196')">&nbsp;</div><div
class="docTitle"><a id="docID_DTS10001196_Link"
href="..../qa/fl/fl10.html#//apple_ref/doc/uid/DTS10001196">Accessing File
Control Blocks</a></div><div id="docID_DTS10001196_details"
class="docDetails"></div></td><td style="display:none;">macOS</td><td
class="resourceTypes">Technical Q&A</td><td class="topics">Data
Management<div class="subtopics">File Management</div></td><td
class="technologies">CoreServices</td><td class="revisionDateandSize"><div
class="docRevisionDate">1999-10-05</div><div class="docRevisionSize">First
Version</div><div
class="docDependencyName"></div></td></tr></tbody></table></div>

```

```

</div>
</div>
<div id="navpage_footer">
<style>
/* PIPED LINKS */
.piped { display: block; zoom: 1; }
.piped:after { content: "."; display: block; height: 0; clear: both; visibility: hidden;
}
.piped li { float: left; display: inline; font-size: 10px;}
.piped a { border-left: 1px solid #797c80; padding: 0 0 0 0.75em; margin-left:
0.75em; }
.piped a.first { border-left: 0 !important; padding-left: 0; margin-left: 0 !
important; }

```

```

#globalfooter * { margin: 0px; padding: 0px;}
#globalfooter ul { list-style: none outside; }

```

```

/*--- Global Footer (legacy) ---*/
#globalfooter .gf-buy { float: left; width: 60%; margin: 18px 0 9px; }
#globalfooter .gf-links { float: right; margin: 18px 0 9px; }
#globalfooter .gf-links a { padding: 0 10px; white-space: nowrap; }
#globalfooter .gf-links a.last { padding-right: 0; _float: none !important; width:
auto !important; }

```

```

/*--- Global Footer ---*/
#globalfooter {color: #888; font-size: 10px; margin: 18px auto; padding-bottom:
36px; text-align: left !important; }
#globalfooter a { color: #08c; }
#globalfooter p { margin-bottom: 1em; font-size: 10px; }
#globalfooter p.gf-buy { float: left; width: 60%; margin: 18px 0 9px 3px; }
#globalfooter ul.piped a { padding: 0 0 0 1.5em; margin-left: 1.5em; border-left:
1px solid #d0d0d0; }
#globalfooter .gf-links { float: right; margin: 18px 3px 9px 0; }
#globalfooter .gf-sosumi { clear: both; width: 100%; border-top: 1px solid #ddd;
padding-top: 9px; }
#globalfooter .gf-sosumi a { padding: 0 10px; }
#globalfooter .gf-sosumi p { float: left; margin-left: 3px; }
#globalfooter form { margin: 18px 10px; }
#globalfooter .search-wrapper { margin: 0 auto; }

```

```
#globalfooter .search-wrapper input.prettysearch { margin-left: 10px; }
#globalfooter ul.piped a.contact_us { padding-right: 1.5em; border-right: 1px
solid #d0d0d0; }
#globalfooter ul.piped a.choose { margin-left: 0; border: 0; }
#globalfooter ul.piped a.choose img { vertical-align: middle; margin-top: -5px;
position: relative; }
</style>
<div id="globalfooter">
```

```
<div class="gf-sosumi">
  <p>Copyright © 2016 Apple Inc. All rights reserved.</p>
  <ul class="piped">
    <li><a href="http://www.apple.com/legal/internet-services/terms/site.html"
target="_blank" class="first">Terms of Use</a></li>
    <li><a href="http://www.apple.com/privacy/" target="_blank">Privacy
Policy</a></li>
  </ul>
</div>
</div><!--/globalfooter-->
```

```
</div>
</div>
```

```
<script type="text/javascript">
  var Book = {
    title: 'Documentation Archive',
    isNavPage: true,
    resourcesURI: '../Resources/1282'
  },
  NavigationPage = {
    searchURI: 'http://developer.apple.com/mac/search/search.php?
results=10&Search=',
    isDocumentTable: true,
    templateName: 'mac',
    doesHaveFrameworks: true,
    frameworksName: 'Technologies',
    doesHaveTopics: true
  };
</script>
<script type="text/javascript"
src="../Resources/1282/JavaScript/navigation_page.js"></script>
```

```
</body></html><html xmlns="https://www.w3.org/1999/xhtml" xml:lang="en"
lang="en"><head>
  <link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=SF+Pro&v=2" type="text/css">
  <link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=SF+Pro+Icons&v=1" type="text/css">
  <link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=SF+Mono&v=2" type="text/css">
  <link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=Apple+Icons&v=1" type="text/css">
```

```
<meta charset="utf-8">
<meta name="Author" content="Apple Inc.">
<meta name="viewport" content="width=device-width, initial-scale=1,
viewport-fit=cover">
<link rel="shortcut icon" href="/favicon.ico">
<link rel="icon" href="/favicon.ico">
<link rel="mask-icon" href="/apple-logo.svg" color="#333333">

<link rel="stylesheet" href="/assets/styles/global.dist.css?41172203193"
type="text/css">

<link rel="stylesheet" href="/assets/styles/localization.css?41172203193"
type="text/css">

<script src="/assets/scripts/lib/jquery/jquery-3.6.0.min.js?41172203193"></
script>
<script src="/assets/scripts/settings.js?41172203193"></script>
<script src="/assets/scripts/language-locales.js?41172203193"></script>
<script src="/assets/scripts/DeveloperBreadcrumbs.js?41172203193"></script>

<script async="" src="/assets/scripts/lib/jquery/jquery.retinade.js?
41172203193"></script>
<script async="" src="/assets/scripts/global.js?41172203193"></script>
<script async="" src="/assets/scripts/global-logout.js?41172203193"></script>

<title>Augmented Reality - Apple Developer</title>
<meta name="omni_page" content="Augmented Reality - (English)">
<meta name="Description" content="Build unparalleled augmented
reality experiences for hundreds of millions of users on iOS and iPadOS, the
biggest AR platforms in the world.">
<meta name="search_icon" content="/assets/elements/icons/arkit/arkit-
96x96_2x.png">

<meta property="og:locale" content="en_US">
<meta property="og:site_name" content="Apple Developer">
<meta property="og:type" content="website">
<meta property="og:image"
content="https://developer.apple.com/news/images/og/arkit-og.png">
<meta property="og:title" content="Augmented Reality - Apple
Developer">
<meta property="og:description" content="Build unparalleled augmented
reality experiences for hundreds of millions of users on iOS and iPadOS, the
biggest AR platforms in the world.">
<meta property="og:url"
content="https://developer.apple.com/augmented-reality/">

<meta name="twitter:card" content="summary_large_image">
<meta name="twitter:image"
content="https://developer.apple.com/news/images/og/arkit-og-twitter.png">
<meta name="twitter:description" content="Build unparalleled
augmented reality experiences for hundreds of millions of users on iOS and
iPadOS, the biggest AR platforms in the world.">
```

```

    <meta name="twitter:title" content="Augmented Reality - Apple Developer">
    <meta name="twitter:url"
content="https://developer.apple.com/augmented-reality/">

    <link rel="stylesheet" href="/augmented-reality/styles/augmented-
reality.css" type="text/css">
    <link rel="stylesheet" href="/augmented-reality/styles/en-overview.css"
type="text/css">

    <link rel="alternate" href="https://developer.apple.com/augmented-
reality/" hreflang="en">
    <link rel="alternate" href="https://developer.apple.com/cn/augmented-
reality/" hreflang="zh-CN">
    <link rel="alternate" href="https://developer.apple.com/jp/augmented-
reality/" hreflang="ja-JP">
    <link rel="alternate" href="https://developer.apple.com/kr/augmented-
reality/" hreflang="ko-KR">
    <link rel="canonical" href="https://developer.apple.com/augmented-
reality/">
</head>

<body id="overview" class="dmf" data-color-scheme="light">

    <link rel="stylesheet" href="/assets/styles/globalnav.css?41172203193"
type="text/css">

    <link rel="stylesheet" href="/assets/styles/suggest-lang.css?41172203193"
type="text/css">
    <div id="suggest-lang" class="ribbon hide">
        <div class="ribbon-content-wrapper">
            <div class="ribbon-content row">
                <div class="column large-12 large-centered">
                    <a id="suggest-closer" class="icon icon-after icon-
reset"></a>
                    <p><a href="#" id="suggest-link" class="ribbon-link
more">View in English</a></p>
                </div>
            </div>
        </div>
    </div>
</div>
<script src="/assets/scripts/suggest-lang.js?41172203193"></script>
<aside id="ac-gn-segmentbar" class="ac-gn-segmentbar" lang="en-US"
dir="ltr">
</aside>
<input type="checkbox" id="ac-gn-menustate" class="ac-gn-menustate">
<nav id="ac-globalnav" class="js touch no-windows" role="navigation" aria-
label="Global" data-hires="false" data-analytics-region="global nav" lang="en-
US" dir="ltr" data-www-domain="www.apple.com" data-store-locale="us" data-
store-root-path="/us" data-store-api="/[storefront]/shop/bag/status" data-
search-locale="en_US"
data-search-suggestions-api="/search-services/suggestions/" data-search-
defaultlinks-api="/search-services/suggestions/defaultlinks/" data-search-
suggestions-enabled="false">

```

```

<div class="ac-gn-content">
  <ul class="ac-gn-header">
    <li class="ac-gn-item ac-gn-menuicon">
      <label class="ac-gn-menuicon-label" for="ac-gn-
menustate" aria-hidden="true">
        <span class="ac-gn-menuicon-bread ac-gn-
menuicon-bread-top">
          <span class="ac-gn-menuicon-bread-
crust ac-gn-menuicon-bread-crust-top"></span>
        </span>
        <span class="ac-gn-menuicon-bread ac-gn-
menuicon-bread-bottom">
          <span class="ac-gn-menuicon-bread-
crust ac-gn-menuicon-bread-crust-bottom"></span>
        </span>
      </label>
      <a href="#ac-gn-menustate" role="button" class="ac-
gn-menuanchor ac-gn-menuanchor-open" id="ac-gn-menuanchor-open">
        <span class="ac-gn-menuanchor-label">Global
Nav Open Menu</span>
      </a>
      <a href="#" role="button" class="ac-gn-menuanchor
ac-gn-menuanchor-close" id="ac-gn-menuanchor-close">
        <span class="ac-gn-menuanchor-label">Global
Nav Close Menu</span>
      </a>
    </li>
    <li class="ac-gn-item ac-gn-apple">
      <a class="ac-gn-link ac-gn-link-apple-developer"
href="/" data-analytics-title="appledeveloper home" id="ac-gn-firstfocus-
small">
        <span class="ac-gn-link-text">Apple
Developer</span>
      </a>
    </li>
  </ul>
  <div class="ac-gn-search-placeholder-container" role="search">
    <div class="ac-gn-search ac-gn-search-small">
      <a id="ac-gn-link-search-small" class="ac-gn-link"
href="/search/" data-analytics-title="search" data-analytics-click="search" data-
analytics-intrapage-link="" aria-label="Search" role="button" aria-
haspopup="true">
        <div class="ac-gn-search-placeholder-bar">
          <div class="ac-gn-search-placeholder-
input">
            <div class="ac-gn-search-
placeholder-input-text" aria-hidden="true">
              <div class="ac-gn-link-
search ac-gn-search-placeholder-input-icon"></div>
              <span class="ac-gn-search-
placeholder">Search</span>
            </div>
          </div>

```



```

        </li>
        <li class="ac-gn-item ac-gn-item-menu ac-gn-account">
            <a class="ac-gn-link ac-gn-link-account"
href="/account/" data-analytics-title="account">
                <span class="ac-gn-link-text">Account</span>
            </a>
        </li>
        <li class="ac-gn-item ac-gn-item-menu ac-gn-search"
role="search">
            <a id="ac-gn-link-search" class="ac-gn-link ac-gn-link-
search" href="/search/" data-analytics-title="search" data-analytics-
click="search" data-analytics-intrapage-link="" aria-label="Search"
role="button" aria-haspopup="true"></a>
        </li>
    </ul>
    <aside id="ac-gn-searchview" class="ac-gn-searchview"
role="search" data-analytics-region="search">
        <div class="ac-gn-searchview-content">
            <div class="ac-gn-searchview-bar">
                <div class="ac-gn-searchview-bar-wrapper">
                    <form id="ac-gn-searchform" class="ac-
gn-searchform" action="/search/" method="get">
                        <div class="ac-gn-searchform-
wrapper">
                            <input id="ac-gn-
searchform-input" class="ac-gn-searchform-input" type="text" name="q" aria-
label="Search" placeholder="Search" autocorrect="off" autocapitalize="off"
autocomplete="off" spellcheck="false" role="combobox" aria-
autocomplete="list" aria-expanded="true" aria-owns="quicklinks suggestions">
                                <button id="ac-gn-
searchform-submit" class="ac-gn-searchform-submit" type="submit"
disabled="" aria-label="Submit Search"></button>
                                    <button id="ac-gn-
searchform-reset" class="ac-gn-searchform-reset" type="reset" disabled=""
aria-label="Clear Search">
                                        <span
class="ac-gn-searchform-reset-background"></span>
                                            </button>
                                                </div>
                                            </form>
                                            <button id="ac-gn-searchview-close-
small" class="ac-gn-searchview-close ac-gn-searchview-close-small" aria-
label="Cancel Search">
                                                <span class="ac-gn-
searchview-close-cancel" aria-hidden="true">
                                                    Cancel
                                                        </span>
                                                    </button>
                                                </div>
                                            </div>
                                            <aside id="ac-gn-searchresults" class="ac-gn-
searchresults" data-string-quicklinks="Quick Links" data-string-
suggestions="Suggested Searches" data-string-noresults="">

```



```

<section class="ac-gn-searchresults-section ac-gn-searchresults-
section-defaultlinks">
  <div class="ac-gn-searchresults-section-wrapper">
    <div class="search-group-
checkbox hidden"><input id="group-input" type="checkbox" name="group-
filter" checked="">Only search within "<span
id="group-search-label"></span>"</div>
    <h3 class="ac-gn-searchresults-header ac-gn-searchresults-
animated">Quick Links</h3>
    <ul class="ac-gn-searchresults-list" id="defaultlinks"
role="listbox">
      <li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a href="https://developer.apple.com/ios/" id="search-group-link-0"
class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">iOS
16</a></li><li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a href="https://developer.apple.com/news/" id="search-group-link-
1" class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">Latest
News</a></li><li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a
href="https://developer.apple.com/documentation/storekit/appstore/
environment/3963900-xcode/" id="search-group-link-2" class="ac-gn-
searchresults-link ac-gn-searchresults-link-defaultlinks">xcode</a></li><li
class="ac-gn-searchresults-item ac-gn-searchresults-animated"><a
href="https://developer.apple.com/xcode/whats-new/" id="search-group-link-3"
class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">What's
included in Xcode</a></li><li class="ac-gn-searchresults-item ac-gn-
searchresults-animated"><a
href="https://developer.apple.com/videos/play/wwdc2022/110345/" id="search-
group-link-4" class="ac-gn-searchresults-link ac-gn-searchresults-link-
defaultlinks">What's new in Endpoint Security</a></li></ul>
    <span role="status" class="ac-gn-searchresults-count" aria-
live="polite">5 Quick Links</span>
  </div>
</section>
</aside>
</div>
  <button id="ac-gn-searchview-close" class="ac-gn-
searchview-close" aria-label="Cancel Search">
    <span class="ac-gn-searchview-close-
wrapper">
      <span class="ac-gn-searchview-close-
left"></span>
      <span class="ac-gn-searchview-close-
right"></span>
    </span>
  </button>
</aside>
</div>
</nav>
<div class="ac-gn-blur"></div>
<div id="ac-gn-curtain" class="ac-gn-curtain"></div>
<div id="ac-gn-placeholder" class="ac-nav-placeholder"></div>
<script src="/assets/scripts/ac-globalnav.built.js?41172203193"></script><div
id="ac-gn-viewport-emitter"> </div>

```

```
<link rel="stylesheet" href="/assets/styles/search.css?41172203193">
<script src="/assets/scripts/search.js?41172203193"></script>
```

```
<!-- metrics -->
<script>
  /* RSID: */
  var s_account="awdappledeveloper"
</script>
<script src="/assets/metrics/scripts/analytics.js?10202020"></script>
<script>
  s.pageName= AC && AC.Tracking && AC.Tracking.pageName();
  s.channel="www.en.developer"
  s.channel="www.en.developer";
```

```
  /***** DO NOT ALTER ANYTHING BELOW THIS LINE ! *****/
  var s_code=s.t();if(s_code)document.write(s_code)
</script>
<!-- /metrics -->
```

```
  <link rel="stylesheet" property="stylesheet"
href="/assets/styles/localnav.css" type="text/css">
<input type="checkbox" id="localnav-menustate" class="localnav-menustate">
<div id="localnav-sticky-placeholder" class="css-sticky
localnav-sticking"></div><nav id="localnav" class="localnav localnav-scrim
css-sticky localnav-sticking" data-sticky="" role="navigation">
  <div class="localnav-wrapper">
    <div class="localnav-background"></div>
    <div class="localnav-content">
      <h2 class="localnav-title">
        <a href="/augmented-reality/">Augmented Reality</a>
      </h2>

      <div class="localnav-menu">
        <a href="#localnav-menustate" class="localnav-menucta-anchor
localnav-menucta-anchor-open" id="localnav-menustate-open">
          <span class="localnav-menucta-anchor-label">Open Menu</span>
        </a>
        <a href="#" class="localnav-menucta-anchor localnav-menucta-
anchor-close" id="localnav-menustate-close">
          <span class="localnav-menucta-anchor-label">Close Menu</span>
        </a>
        <div class="localnav-menu-tray">
          <ul class="localnav-menu-items">
            <li class="localnav-menu-item">
              <a href="/augmented-reality/" class="localnav-menu-link
current" aria-disabled="true">Overview</a>
            </li>
            <li class="localnav-menu-item">
              <a href="/augmented-reality/arkit/" class="localnav-menu-
link">ARKit</a>
            </li>
            <li class="localnav-menu-item">
```


Build unparalleled augmented reality experiences for hundreds of millions of users on iOS and iPadOS, the biggest AR platforms in the world. With powerful frameworks like ARKit and RealityKit, and creative tools like Reality Composer and Reality Converter, it's never been easier to bring your ideas to life in AR.

RealityKit

RealityKit gives you more control and customization over the AR experiences you create. With APIs like Custom Rendering, Metal Shaders, and Post Processing, you have more control over the rendering pipeline and more flexibility to create entirely new worlds in AR. And with the Object Capture API, you can create unique 3D objects that are optimized for AR in minutes using state-of-the-art photogrammetry algorithms.

[Learn more](/augmented-reality/realitykit/)

AR creation tools

Reality Composer is a powerful tool that makes it easy for you to create interactive augmented reality experiences with no prior 3D experience. Reality Converter quickly converts your existing 3D models to USDZ so it works seamlessly in our tools and on all AR-enabled iPhone and iPad devices.

[Learn more](/augmented-reality/tools/)

url("https://developer.apple.com/assets/elements/hardware/macbook_pro_space_grey/small_2x.png?156454");">

<figure class="device-screen screen-creation" data-hires-status="pending"></figure>

</figure>

</section>

<section class="section section-gallery">

<div class="section-content">

<div class="row">

<div class="column large-centered large-7 medium-10 small-12 text-center">

<h2 class="typography-subsection-headline">AR Quick Look</h2>

<p>Place 3D objects in the real world using AR Quick Look, powered by ARKit. AR Quick Look also supports models and scenes created in Reality Composer, so you can easily create interactive experiences to be shared and viewed on iPhone and iPad.</p>

<p>View the Quick Look Gallery</p>

</div>

</div>

<div class="row row-models">

<div class="column large-centered large-11 medium-12">

<div class="row">

<div class="column large-3 text-center">

<figure class="image-model model-drummertoy" data-hires-status="pending"></figure>

</div>

<div class="column large-3 text-center">

<figure class="image-model model-biplane" data-hires-status="pending"></figure>

</div>

<div class="column large-3 text-center">

<figure class="image-model model-vintagerobot2k" data-hires-status="pending"></figure>

</div>

<div class="column large-3 text-center">

<figure class="image-model model-toycar" data-hires-status="pending"></figure>

</div>

</div>

</div>

</div>

</div>

</section>

```

        <section class="section section-new bg-blue-gradient-alt" data-
hires-status="pending">
            <div class="section-content">
                <div class="row">
                    <div class="large-centered large-7 small-12
text-center">
                        <figure class="icon-app-store center"
data-hires-status="pending"></figure>
                        <h2>AR on the <span
class="nowrap">App Store</span></h2>
                        <p>Discover the unique apps and games
that other developers have created with ARKit. If you're creating an amazing
experience with ARKit and would like to share it with us, <a
href="/contact/arkit/" class="nowrap">let us know</a>.</p>
                        <p><a
href="https://apps.apple.com/story/id1288297581">View on the <span
class="more nowrap">App Store</span></a></p>
                    </div>
                </div>
            </div>
        </section>

        <section class="section section-resources bg-light">
            <div class="section-content">
                <div class="row">
                    <div class="column large-centered large-7
medium-9 small-12 text-center">
                        <figure class="router-icon-service center"
data-hires-status="pending"></figure>
                        <h2>Resources</h2>
                        <p>Find the tools and documentation you
need to create AR experiences.</p>
                        <p><a
href="/augmented-reality/resources/" class="more">View resources</a></p>
                    </div>
                </div>
            </div>
        </section>

    </main>

    <link rel="stylesheet" href="/assets/styles/footer.dist.css?
41172203193">
    <footer id="footer" class="footer" role="contentinfo" aria-labelledby="footer-
label">
        <div class="footer-content">
            <h2 class="footer-label" id="footer-label">Developer Footer</h2>
            <developer-breadcrumbs style="display: block;">

            <nav class="footer-breadcrumbs" aria-label="Breadcrumbs"><a
href="https://www.apple.com/" class="home footer-breadcrumbs-home"><span
class="footer-breadcrumbs-home-icon" aria-hidden="true" data-hires-

```

```

status="pending"></span><span class="footer-breadcrumbs-home-label">Apple</span></a><div class="footer-breadcrumbs-path"><ol class="footer-breadcrumbs-list"><li class="footer-breadcrumbs-item"><a href="/">Developer</a></li><li class="footer-breadcrumbs-item">Augmented Reality</li></ol></div></nav></developer-breadcrumbs>
    <nav class="footer-directory" aria-label="Apple Developer Directory" role="navigation">
        <!--googleoff: all-->
        <div class="footer-directory-column">
            <input class="footer-directory-column-section-state" type="checkbox" id="footer-directory-column-section-state-platform">
            <div class="footer-directory-column-section">
                <label class="footer-directory-column-section-label" for="footer-directory-column-section-state-platform">
                    <h3 class="footer-directory-column-section-title">Platforms</h3>
                    </label>
                    <a href="#footer-directory-column-section-state-platform" class="footer-directory-column-section-anchor footer-directory-column-section-anchor-open"> <span class="footer-directory-column-section-anchor-label">Open Menu</span> </a>
                    <a href="#" class="footer-directory-column-section-anchor footer-directory-column-section-anchor-close"> <span class="footer-directory-column-section-anchor-label">Close Menu</span> </a>
                    <ul class="footer-directory-column-section-list">
                        <li class="footer-directory-column-section-item"><a class="footer-directory-column-section-link" href="/ios/">iOS</a></li>
                        <li class="footer-directory-column-section-item"><a class="footer-directory-column-section-link" href="/ipados/">iPadOS</a></li>
                        <li class="footer-directory-column-section-item"><a class="footer-directory-column-section-link" href="/macos/">macOS</a></li>
                        <li class="footer-directory-column-section-item"><a class="footer-directory-column-section-link" href="/tvos/">tvOS</a></li>
                        <li class="footer-directory-column-section-item"><a class="footer-directory-column-section-link" href="/watchos/">watchOS</a></li>
                    </ul>
                </div>

                <input class="footer-directory-column-section-state" type="checkbox" id="footer-directory-column-section-state-tools">
                <div class="footer-directory-column-section">
                    <label class="footer-directory-column-section-label" for="footer-directory-column-section-state-tools">
                        <h3 class="footer-directory-column-section-title">Tools</h3>
                        </label>
                        <a href="#footer-directory-column-section-state-tools" class="footer-directory-column-section-anchor footer-directory-column-section-anchor-open"> <span class="footer-directory-column-section-anchor-label">Open Menu</span> </a>
                        <a href="#" class="footer-directory-column-section-anchor footer-directory-column-section-anchor-close"> <span class="footer-directory-column-section-anchor-label">Close Menu</span> </a>

```

```

        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/swift/">Swift</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/swiftui/">SwiftUI</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/swift-playgrounds/">Swift
Playgrounds</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/testflight/">TestFlight</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/xcode/">Xcode</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/xcode-cloud/">Xcode
Cloud</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/sf-symbols/">SF
Symbols</a></li>
        </ul>
    </div>
</div>

```

```

<div class="footer-directory-column">
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-topics">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-topics">
            <h3 class="footer-directory-column-section-
title">Topics & Technologies</h3>
            </label>
            <a href="#footer-directory-column-section-state-topics"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
            <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
            <ul class="footer-directory-column-section-list">
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/accessibility/">Accessibility</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/accessories/">Accessories</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-extensions/">App
Extensions</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-store/">App
Store</a></li>
            </ul>
        </div>
    </div>

```



```

        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/audio/">Audio &
Video</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/augmented-
reality/">Augmented Reality</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/business/">Business</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/design/">Design</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/distribute/">Distribution</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/education/">Education</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/fonts/">Fonts</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/games/">Games</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/health-fitness/">Health
& Fitness</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/in-app-purchase/">In-App
Purchase</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/localization/">Localization</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/maps/">Maps &
Location</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/machine-learning/">Machine
Learning</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/security/">Security</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/safari/">Safari &
Web</a></li>
    </ul>
</div>
</div>

```

```

<div class="footer-directory-column">
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-resources">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-resources">
            <h3 class="footer-directory-column-section-
title">Resources</h3>

```

```
        </label>
        <a href="#footer-directory-column-section-state-resources"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
        <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/documentation/">Documentation</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/learn/curriculum/">Curriculum</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/download/">Downloads</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="https://developer.apple.com/forums/">Forums</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/videos/">Videos</a></li>
        </ul>
    </div>
```

```
        <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-support">
        <div class="footer-directory-column-section">
            <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-support">
                <h3 class="footer-directory-column-section-
title">Support</h3>
            </label>
            <a href="#footer-directory-column-section-state-support"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
            <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
            <ul class="footer-directory-column-section-list">
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/support/articles/">Support
Articles</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/contact/">Contact
Us</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/bug-reporting/">Bug
Reporting</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/system-status/">System
Status</a></li>
```

```

        </ul>
    </div>

    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-account">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-account">
            <h3 class="footer-directory-column-section-
title">Account</h3>
            </label>
            <a href="#footer-directory-column-section-state-account"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
            <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
            <ul class="footer-directory-column-section-list">
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/account/">Apple
Developer</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="https://appstoreconnect.apple.com/">App Store Connect</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/account/ios/certificate/">Certificates, IDs, & Profiles</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="https://feedbackassistant.apple.com/">Feedback Assistant</a></li>
            </ul>
        </div>
    </div>

    <div class="footer-directory-column">
        <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-programs">
        <div class="footer-directory-column-section">
            <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-programs">
                <h3 class="footer-directory-column-section-
title">Programs</h3>
                </label>
                <a href="#footer-directory-column-section-state-programs"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
                <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
                <ul class="footer-directory-column-section-list">

```

```
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/">Apple Developer
Program</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/enterprise/">Apple
Developer Enterprise Program</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-store/small-business-
program/">App Store Small Business Program</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="https://mfi.apple.com/">MFi
Program</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/news-
partner/">News Partner Program</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/video-
partner/">Video Partner Program</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/security-bounty/">Security
Bounty Program</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/security-research-
device/">Security Research Device Program</a></li>
    </ul>
</div>
```

```
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-events">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-events">
            <h3 class="footer-directory-column-section-
title">Events</h3>
        </label>
        <a href="#footer-directory-column-section-state-events"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
        <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/accelerator/">App
Accelerators</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-store/app-store-
awards/">App Store Awards</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/design/awards/">Apple
Design Awards</a></li>
```

```

        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/learn/experts/#academies">Apple Developer Academies</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/entrepreneur-
camp/">Entrepreneur Camp</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/tech-talks/">Tech
Talks</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/wwdc/">WWDC</a></li>
    </ul>
</div>
</div>
<!--googleon: all-->
</nav>
<section class="footer-mini" vocab="http://schema.org/"
typeof="Organization">
    <div class="footer-mini-news">
        <div class="copy">
            To view the latest developer news, visit <a
href="/news/">News and Updates</a>.
        </div>
        <div class="content">
            <div class="color-scheme-toggle" role="radiogroup"
tabindex="0" aria-label="Select a color scheme preference">

                <label data-color-scheme-option="light">

                    <input type="radio" value="light"

autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">

                    <div class="text">Light</div>

                </label>

                <label data-color-scheme-option="dark">

                    <input type="radio" value="dark"

autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">

                    <div class="text">Dark</div>

                </label>

                <label data-color-scheme-option="auto">

                    <input type="radio" value="auto"

autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">

                    <div class="text">Auto</div>

```

```

        </label>

        </div>
        <script async="" src="/assets/scripts/color-scheme-
toggle.js"></script>
    </div>
</div>
    <link rel="stylesheet" href="/assets/styles/language-dropdown.css?
41172203193">
    <div class="language-dropdown dropdown-container" data-
lang="complete">
        <select class="dropdown" aria-label="Language
Dropdown"><option value="https://developer.apple.com/augmented-
reality/">English</option><option
value="https://developer.apple.com/cn/augmented-reality/">□□□□</option><opt
ion value="https://developer.apple.com/jp/augmented-reality/">□□
□</option><option value="https://developer.apple.com/kr/augmented-reality/">
□□□</option></select>
        <span class="dropdown-icon icon icon-chevron-down" aria-
hidden="true"></span>
    </div>
    <script async="" src="/assets/scripts/lib/jquery/jquery.language-
dropdown.js?41172203193"></script>
    <div class="footer-mini-legal">
        <div class="footer-mini-legal-copyright">Copyright © 2022 <a
href="https://www.apple.com">Apple Inc.</a> All rights reserved.</div>
        <div class="footer-mini-legal-links">
            <a class="footer-mini-legal-link"
href="https://www.apple.com/legal/internet-services/terms/site.html">Terms of
Use</a>
            <a class="footer-mini-legal-link"
href="https://www.apple.com/legal/privacy/en-ww/">Privacy Policy</a>
            <a class="footer-mini-legal-link"
href="/support/terms/">Agreements and Guidelines</a>
        </div>
    </div>
</section>
</div>
</footer>

</body></html>

<html xmlns="https://www.w3.org/1999/xhtml" xml:lang="en"
lang="en"><head>
    <link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=SF+Pro&v=2" type="text/css">
    <link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=SF+Pro+Icons&v=1" type="text/css">
    <link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=SF+Mono&v=2" type="text/css">
    <link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=Apple+Icons&v=1" type="text/css">

```

```

    <meta charset="utf-8">
    <meta name="Author" content="Apple Inc.">
    <meta name="viewport" content="width=device-width, initial-scale=1,
    viewport-fit=cover">
    <link rel="shortcut icon" href="/favicon.ico">
    <link rel="icon" href="/favicon.ico">
    <link rel="mask-icon" href="/apple-logo.svg" color="#333333">

    <link rel="stylesheet" href="/assets/styles/global.dist.css?41172203193"
    type="text/css">

    <link rel="stylesheet" href="/assets/styles/localization.css?41172203193"
    type="text/css">

    <script src="/assets/scripts/lib/jquery/jquery-3.6.0.min.js?41172203193"></
    script>
    <script src="/assets/scripts/settings.js?41172203193"></script>
    <script src="/assets/scripts/language-locales.js?41172203193"></script>
    <script src="/assets/scripts/DeveloperBreadcrumbs.js?41172203193"></script>

    <script async="" src="/assets/scripts/lib/jquery/jquery.retinade.js?
    41172203193"></script>
    <script async="" src="/assets/scripts/global.js?41172203193"></script>
    <script async="" src="/assets/scripts/global-logout.js?41172203193"></script>

    <title>RealityKit Overview - Augmented Reality - Apple Developer</title>
    <meta name="omni_page" content="RealityKit - Augmented Reality -
    (English)">
    <meta name="Description" content="Use the Reality Composer app and
    RealityKit to build animations and interactions in iOS and macOS to enrich your
    3D content.">

    <meta property="og:locale" content="en_US">
    <meta property="og:site_name" content="Apple Developer">
    <meta property="og:type" content="website">
    <meta property="og:image"
    content="https://developer.apple.com/news/images/og/realitykit-og.jpg">
    <meta property="og:title" content="RealityKit Overview - Augmented
    Reality - Apple Developer">
    <meta property="og:description" content="Use the Reality Composer app
    and RealityKit to build animations and interactions in iOS and macOS to enrich
    your 3D content.">
    <meta property="og:url"
    content="https://developer.apple.com/augmented-reality/realitykit/">

    <meta name="twitter:card" content="summary_large_image">
    <meta name="twitter:image"
    content="https://developer.apple.com/news/images/og/realitykit-og-twitter.jpg">
    <meta name="twitter:description" content="Use the Reality Composer
    app and RealityKit to build animations and interactions in iOS and macOS to
    enrich your 3D content.">
    <meta name="twitter:title" content="RealityKit Overview - Augmented
    Reality - Apple Developer">

```

```

    <meta name="twitter:url"
content="https://developer.apple.com/augmented-reality/realidadkit/">

    <link rel="stylesheet" href="/augmented-reality/styles/augmented-
reality.css" type="text/css">
    <link rel="stylesheet" href="/augmented-reality/styles/realidadkit-alt.css"
type="text/css">

    <link rel="alternate" href="https://developer.apple.com/augmented-
reality/realidadkit/" hreflang="en">
    <link rel="alternate" href="https://developer.apple.com/cn/augmented-
reality/realidadkit/" hreflang="zh-CN">
    <link rel="alternate" href="https://developer.apple.com/jp/augmented-
reality/realidadkit/" hreflang="ja-JP">
    <link rel="alternate" href="https://developer.apple.com/kr/augmented-
reality/realidadkit/" hreflang="ko-KR">
    <link rel="canonical" href="https://developer.apple.com/augmented-
reality/realidadkit/">
</head>

<body id="reality-kit" class="dmf" data-color-scheme="light">

    <link rel="stylesheet" href="/assets/styles/globalnav.css?41172203193"
type="text/css">

    <link rel="stylesheet" href="/assets/styles/suggest-lang.css?41172203193"
type="text/css">
    <div id="suggest-lang" class="ribbon hide">
        <div class="ribbon-content-wrapper">
            <div class="ribbon-content row">
                <div class="column large-12 large-centered">
                    <a id="suggest-closer" class="icon icon-after icon-
reset"></a>
                    <p><a href="#" id="suggest-link" class="ribbon-link
more">View in English</a></p>
                </div>
            </div>
        </div>
    </div>
</div>
<script src="/assets/scripts/suggest-lang.js?41172203193"></script>
<aside id="ac-gn-segmentbar" class="ac-gn-segmentbar" lang="en-US"
dir="ltr">
</aside>
<input type="checkbox" id="ac-gn-menustate" class="ac-gn-menustate">
<nav id="ac-globalnav" class="js touch no-windows" role="navigation" aria-
label="Global" data-hires="false" data-analytics-region="global nav" lang="en-
US" dir="ltr" data-www-domain="www.apple.com" data-store-locale="us" data-
store-root-path="/us" data-store-api="/[storefront]/shop/bag/status" data-
search-locale="en_US"
data-search-suggestions-api="/search-services/suggestions/" data-search-
defaultlinks-api="/search-services/suggestions/defaultlinks/" data-search-
suggestions-enabled="false">
    <div class="ac-gn-content">
        <ul class="ac-gn-header">

```



```

        <li class="ac-gn-item ac-gn-menuicon">
            <label class="ac-gn-menuicon-label" for="ac-gn-
menustate" aria-hidden="true">
                <span class="ac-gn-menuicon-bread ac-gn-
menuicon-bread-top">
                    <span class="ac-gn-menuicon-bread-
crust ac-gn-menuicon-bread-crust-top"></span>
                    </span>
                <span class="ac-gn-menuicon-bread ac-gn-
menuicon-bread-bottom">
                    <span class="ac-gn-menuicon-bread-
crust ac-gn-menuicon-bread-crust-bottom"></span>
                    </span>
                </label>
                <a href="#ac-gn-menustate" role="button" class="ac-
gn-menuanchor ac-gn-menuanchor-open" id="ac-gn-menuanchor-open">
                    <span class="ac-gn-menuanchor-label">Global
Nav Open Menu</span>
                    </a>
                <a href="#" role="button" class="ac-gn-menuanchor
ac-gn-menuanchor-close" id="ac-gn-menuanchor-close">
                    <span class="ac-gn-menuanchor-label">Global
Nav Close Menu</span>
                    </a>
                </li>
                <li class="ac-gn-item ac-gn-apple">
                    <a class="ac-gn-link ac-gn-link-apple-developer"
href="/" data-analytics-title="appledeveloper home" id="ac-gn-firstfocus-
small">
                        <span class="ac-gn-link-text">Apple
Developer</span>
                    </a>
                </li>
            </ul>
            <div class="ac-gn-search-placeholder-container" role="search">
                <div class="ac-gn-search ac-gn-search-small">
                    <a id="ac-gn-link-search-small" class="ac-gn-link"
href="/search/" data-analytics-title="search" data-analytics-click="search" data-
analytics-intrapage-link="" aria-label="Search" role="button" aria-
haspopup="true">
                        <div class="ac-gn-search-placeholder-bar">
                            <div class="ac-gn-search-placeholder-
input">
                                <div class="ac-gn-search-
placeholder-input-text" aria-hidden="true">
                                    <div class="ac-gn-link-
search ac-gn-search-placeholder-input-icon"></div>
                                    <span class="ac-gn-search-
placeholder">Search</span>
                                </div>
                                <div class="ac-gn-searchview-close ac-
gn-searchview-close-small ac-gn-search-placeholder-searchview-close">

```

```

                                <span class="ac-gn-searchview-
close-cancel" aria-hidden="true">Cancel</span>
                                </div>
                            </div>
                        </a>
                    </div>
                </div>
            <ul class="ac-gn-list">
                <li class="ac-gn-item ac-gn-apple">
                    <a class="ac-gn-link ac-gn-link-apple-developer"
href="/" data-analytics-title="appledeveloper home" id="ac-gn-firstfocus">
                        <span class="ac-gn-link-text">Apple
Developer</span>
                    </a>
                </li>
                <li class="ac-gn-item ac-gn-item-menu ac-gn-news">
                    <a class="ac-gn-link ac-gn-link-news" href="/news/"
data-analytics-title="news">
                        <span class="ac-gn-link-text">News</span>
                    </a>
                </li>
                <li class="ac-gn-item ac-gn-item-menu ac-gn-discover">
                    <a class="ac-gn-link ac-gn-link-discover"
href="/discover/" data-analytics-title="discover">
                        <span
class="ac-gn-link-text">Discover</span>
                    </a>
                </li>
                <li class="ac-gn-item ac-gn-item-menu ac-gn-design">
                    <a class="ac-gn-link ac-gn-link-design" href="/design/"
data-analytics-title="design">
                        <span class="ac-gn-link-text">Design</span>
                    </a>
                </li>
                <li class="ac-gn-item ac-gn-item-menu ac-gn-develop">
                    <a class="ac-gn-link ac-gn-link-develop"
href="/develop/" data-analytics-title="develop">
                        <span class="ac-gn-link-text">Develop</span>
                    </a>
                </li>
                <li class="ac-gn-item ac-gn-item-menu ac-gn-distribute">
                    <a class="ac-gn-link ac-gn-link-distribute"
href="/distribute/" data-analytics-title="distribute">
                        <span
class="ac-gn-link-text">Distribute</span>
                    </a>
                </li>
                <li class="ac-gn-item ac-gn-item-menu ac-gn-dsupport">
                    <a class="ac-gn-link ac-gn-link-dsupport"
href="/support/" data-analytics-title="dsupport">
                        <span class="ac-gn-link-text">Support</span>
                    </a>
                </li>
                <li class="ac-gn-item ac-gn-item-menu ac-gn-account">

```

```

        <a class="ac-gn-link ac-gn-link-account"
href="/account/" data-analytics-title="account">
        <span class="ac-gn-link-text">Account</span>
        </a>
    </li>
    <li class="ac-gn-item ac-gn-item-menu ac-gn-search"
role="search">
        <a id="ac-gn-link-search" class="ac-gn-link ac-gn-link-
search" href="/search/" data-analytics-title="search" data-analytics-
click="search" data-analytics-intrapage-link="" aria-label="Search"
role="button" aria-haspopup="true"></a>
    </li>
</ul>
<aside id="ac-gn-searchview" class="ac-gn-searchview"
role="search" data-analytics-region="search">
    <div class="ac-gn-searchview-content">
        <div class="ac-gn-searchview-bar">
            <div class="ac-gn-searchview-bar-wrapper">
                <form id="ac-gn-searchform" class="ac-
gn-searchform" action="/search/" method="get">
                    <div class="ac-gn-searchform-
wrapper">
                        <input id="ac-gn-
searchform-input" class="ac-gn-searchform-input" type="text" name="q" aria-
label="Search" placeholder="Search" autocorrect="off" autocapitalize="off"
autocomplete="off" spellcheck="false" role="combobox" aria-
autocomplete="list" aria-expanded="true" aria-owns="quicklinks suggestions">
                        <button id="ac-gn-
searchform-submit" class="ac-gn-searchform-submit" type="submit"
disabled="" aria-label="Submit Search"></button>
                        <button id="ac-gn-
searchform-reset" class="ac-gn-searchform-reset" type="reset" disabled=""
aria-label="Clear Search">
                            <span
class="ac-gn-searchform-reset-background"></span>
                            </button>
                        </div>
                    </form>
                    <button id="ac-gn-searchview-close-
small" class="ac-gn-searchview-close ac-gn-searchview-close-small" aria-
label="Cancel Search">
                        <span class="ac-gn-
searchview-close-cancel" aria-hidden="true">
                            Cancel
                        </span>
                    </button>
                </div>
            </div>
        <div class="ac-gn-searchview-close ac-gn-searchview-close-small" aria-
label="Cancel Search">
            <span class="ac-gn-
searchview-close-cancel" aria-hidden="true">
                Cancel
            </span>
        </div>
    </div>
</div>
<aside id="ac-gn-searchresults" class="ac-gn-
searchresults" data-string-quicklinks="Quick Links" data-string-
suggestions="Suggested Searches" data-string-noresults="">
    <section class="ac-gn-searchresults-section ac-gn-searchresults-
section-defaultlinks">
        <div class="ac-gn-searchresults-section-wrapper">

```

```

checkbox hidden"><input id="group-input" type="checkbox" name="group-
filter" checked="">Only search within "<span
id="group-search-label"></span>"</div>
    <h3 class="ac-gn-searchresults-header ac-gn-searchresults-
animated">Quick Links</h3>
    <ul class="ac-gn-searchresults-list" id="defaultlinks"
role="listbox">
        <li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a href="https://developer.apple.com/ios/" id="search-group-link-0"
class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">iOS
16</a></li><li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a href="https://developer.apple.com/news/" id="search-group-link-
1" class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">Latest
News</a></li><li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a
href="https://developer.apple.com/documentation/storekit/appstore/
environment/3963900-xcode/" id="search-group-link-2" class="ac-gn-
searchresults-link ac-gn-searchresults-link-defaultlinks">xcode</a></li><li
class="ac-gn-searchresults-item ac-gn-searchresults-animated"><a
href="https://developer.apple.com/xcode/whats-new/" id="search-group-link-3"
class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">What's
included in Xcode</a></li><li class="ac-gn-searchresults-item ac-gn-
searchresults-animated"><a
href="https://developer.apple.com/videos/play/wwdc2022/110345/" id="search-
group-link-4" class="ac-gn-searchresults-link ac-gn-searchresults-link-
defaultlinks">What's new in Endpoint Security</a></li></ul>
        <span role="status" class="ac-gn-searchresults-count" aria-
live="polite">5 Quick Links</span>
    </div>
</section>
</aside>
</div>
    <button id="ac-gn-searchview-close" class="ac-gn-
searchview-close" aria-label="Cancel Search">
        <span class="ac-gn-searchview-close-
wrapper">
            <span class="ac-gn-searchview-close-
left"></span>
            <span class="ac-gn-searchview-close-
right"></span>
        </span>
    </button>
</aside>
</div>
</nav>
<div class="ac-gn-blur"></div>
<div id="ac-gn-curtain" class="ac-gn-curtain"></div>
<div id="ac-gn-placeholder" class="ac-nav-placeholder"></div>
<script src="/assets/scripts/ac-globalnav.built.js?41172203193"></script><div
id="ac-gn-viewport-emitter"></div>
<link rel="stylesheet" href="/assets/styles/search.css?41172203193">
<script src="/assets/scripts/search.js?41172203193"></script>

```

```

        <!-- metrics -->
<script>
    /* RSID: */
    var s_account="awdappledeveloper"
</script>
<script src="/assets/metrics/scripts/analytics.js?10202020"></script>
<script>
    s.pageName= AC && AC.Tracking && AC.Tracking.pageName();
    s.channel="www.en.developer"
    s.channel="www.en.developer";

    /***** DO NOT ALTER ANYTHING BELOW THIS LINE ! *****/
    var s_code=s.t();if(s_code)document.write(s_code)
</script>
<!-- /metrics -->

    <link rel="stylesheet" property="stylesheet"
href="/assets/styles/localnav.css" type="text/css">
<input type="checkbox" id="localnav-menustate" class="localnav-menustate">
<div id="localnav-sticky-placeholder" class="css-sticky"></div><nav
id="localnav" class="localnav localnav-scrim css-sticky" data-sticky=""
role="navigation">
    <div class="localnav-wrapper">
        <div class="localnav-background"></div>
        <div class="localnav-content">
            <h2 class="localnav-title">
                <a href="/augmented-reality/">Augmented Reality</a>
            </h2>

            <div class="localnav-menu">
                <a href="#localnav-menustate" class="localnav-menucta-anchor
localnav-menucta-anchor-open" id="localnav-menustate-open">
                    <span class="localnav-menucta-anchor-label">Open Menu</span>
                </a>
                <a href="#" class="localnav-menucta-anchor localnav-menucta-
anchor-close" id="localnav-menustate-close">
                    <span class="localnav-menucta-anchor-label">Close Menu</span>
                </a>
                <div class="localnav-menu-tray">
                    <ul class="localnav-menu-items">
                        <li class="localnav-menu-item">
                            <a href="/augmented-reality/" class="localnav-menu-
link">Overview</a>
                        </li>
                        <li class="localnav-menu-item">
                            <a href="/augmented-reality/arkit/" class="localnav-menu-
link">ARKit</a>
                        </li>
                        <li class="localnav-menu-item">
                            <a href="/augmented-reality/realitykit/" class="localnav-menu-
link current" aria-disabled="true">RealityKit</a>
                        </li>
                        <li class="localnav-menu-item">

```

```

        <a href="/augmented-reality/roomplan/" class="localnav-
menu-link">RoomPlan</a>
    </li>
    <li class="localnav-menu-item">
        <a href="/augmented-reality/tools/" class="localnav-menu-
link">AR Creation Tools</a>
    </li>
    <li class="localnav-menu-item">
        <a href="/augmented-reality/quick-look/" class="localnav-
menu-link">AR Quick Look</a>
    </li>
    <li class="localnav-menu-item">
        <a href="/augmented-reality/resources/" class="localnav-
menu-link">Resources</a>
    </li>
</ul>
</div>
<div class="localnav-actions localnav-actions">
    <div class="localnav-action localnav-action-menucta" aria-
hidden="true">
        <label for="localnav-menustate" class="localnav-menucta">
            <span class="localnav-menucta-chevron"></span>
        </label>
    </div>
</div>
</div>
</div>
</div>
</div>
</nav>
<label id="localnav-curtain" for="localnav-menustate"></label>
<script src="/assets/scripts/ac-localnav.built.js"></script><div id="localnav-
viewport-emitter" data-viewport-emitter-dispatch="" data-viewport-emitter-
state="{&quot;viewport&quot;;&quot;small&quot;;&quot;orientation&quot;;&quot;
t;portrait&quot;;&quot;retina&quot;;true}"></div>
<script type="text/javascript" src="/assets/scripts/localnav.js"></script>

```

```

<main id="main" class="main" role="main">

    <section class="section section-hero">
        <div class="section-content">
            <div class="row">
                <div class="large-centered large-9 small-12
text-center">
                    <figure class="icon-realitykit center"
data-hires-status="pending"></figure>
                    <h1 class="typography-
headline">RealityKit</h1>
                    <p class="typography-intro">The
RealityKit framework was built from the ground up specifically for augmented
reality with photo-realistic rendering, camera effects, animations, physics, and
more. With native Swift APIs, ARKit integration, incredibly realistic physics-based
rendering, transform and skeletal animations, spatial audio, and rigid body

```

physics, RealityKit makes AR development faster and easier than ever before.</p>

</div>
</div>
</div>
<div class="device-hero device-ipad-pro-12-9-space-gray-container center">
<figure class="device-screen screen-hero" data-hires-status="pending"></figure>
<figure class="device-hardware" data-hires-status="pending" style="background-image: url("https://developer.apple.com/assets/elements/hardware/ipad_pro_12_9_space_gray/small_2x.png?156454");"></figure>
</div>
</section>

<section class="section section-realitykit bg-yellow" data-hires-status="pending">
<div class="section-content">
<div class="row headline-row">
<div class="column large-centered large-12">

</div>
</div>
<div class="row">
<div class="column large-4 small-12">
<div class="device-wrap device-iphone-12-pro-silver-container device-medium-for-small">
<figure class="device-screen screen-object-capture" data-hires-status="pending"></figure>
<figure class="device-hardware" data-hires-status="pending" style="background-image: url("https://developer.apple.com/assets/elements/hardware/iphone_12_pro_silver/medium_2x.png?156454");"></figure>
</div>
</div>
<div class="column large-7 medium-8 small-12">

<h3>Object Capture</h3>
<p>Turn photos from your iPhone or iPad into photo-realistic 3D models that are optimized for AR in minutes* using the new Object Capture API on macOS. Object Capture uses photogrammetry to turn a series of pictures taken on your iPhone or iPad into 3D models that can be viewed instantly in AR Quick Look, or integrated into your Xcode project.</p>

Learn more

</div>
</div>
</div>
</section>

<section class="section section-more">

```

<div class="section-content">
  <div class="row">
    <div class="column large-5 small-12">
      <h3>Custom shaders</h3>
      <p>RealityKit seamlessly blends virtual
content with the real world using realistic, physically based materials,
environment reflections, grounding shadows, camera noise, motion blur, and
more to make virtual content nearly indistinguishable from reality. <span
class="nowrap">RealityKit</span> gives you more control over the rendering
pipeline with custom render targets and materials, so you can fine-tune the look
and feel of your AR objects and scene.</p>

      <h3>Custom systems</h3>
      <p>Build your own Entity Component
System so you can organize the assets in your AR scene and build more complex
functionality into the system layer.</p>

      <h3>Object occlusion</h3>
      <p>By combining information from the
LiDAR Scanner and edge detection in RealityKit, virtual objects are able to
interact with your physical surroundings just as you'd expect. Virtual objects can
be placed under tables, behind walls, or around corners and you'll see only the
parts of the virtual object you'd expect to, with crisp definition of where the
physical object hides part of the virtual one.</p>

      <h3>Video texture</h3>
      <p>You can now add video textures to
any part of your scene in RealityKit. This brings objects, surfaces, and even
characters to life by adding rich video to animate virtual TV screens to play a
movie, or make a virtual character smile.</p>

      <h3>Swift API</h3>
      <p>Easy to use yet incredibly powerful,
RealityKit uses the rich language features of Swift to automatically provide the
full feature set, so you can build AR experiences even more quickly, without the
need for boilerplate code.</p>
    </div>
    <div class="column large-offset-2 large-5 small-
offset-0 small-12">
      <h3>Dynamic assets</h3>
      <p>Enable customizable loading for
assets to give you more flexibility to tailor your RealityKit-based experiences —
for example, programmatically changing an image or mesh with every
frame.</p>

      <h3>Character Controller</h3>
      <p>Easily create player-controlled
characters using this powerful Swift API, so your users can jump, scale,
and explore the AR worlds and RealityKit-based games you create.</p>

      <h3>Scalable performance</h3>
      <p>Utilizing the latest Metal features to
get the most out of the GPU, RealityKit takes full advantage of CPU caches and
multiple cores to deliver incredibly fluid visuals and physics simulations. And

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because it automatically scales the performance of an AR experience to each iPhone or iPad, you only need to build a single AR experience.</p>

<h3>Shared AR experiences</h3>

<p>RealityKit simplifies building shared AR experiences by taking on the hard work of networking, such as maintaining a consistent state, optimizing network traffic, handling packet loss, or performing ownership transfers.</p>

</div>

</div>

</div>

</section>

</main>

<link rel="stylesheet" property="stylesheet" href="/assets/styles/router-strip.css" type="text/css">

<aside class="section developer-router-links">

<div class="section-content">

<div class="row">

<div class="column large-centered large-10 small-12 text-center">

<h2 class="typography-subsection-headline">Resources and documentation</h2>

<p>View the latest documentation, sample code, videos, and forums.</p>

</div>

</div>

<div class="row">

<div class="column large-3 medium-6 small-12">

<figure class="router-icon router-icon-download" data-hires-status="pending"></figure>

<p>SDKs and betas</p>

<p class="typography-subbody">Download SDKs and beta operating systems for all Apple platforms.</p>

<p class="typography-subbody">View Downloads</p>

</div>

<div class="column large-3 medium-6 small-12">

<figure class="router-icon router-icon-document" data-hires-status="pending"></figure>

<p>Documentation</p>

<p class="typography-subbody">Browse the latest documentation including API reference, articles, and sample code.</p>

<p class="typography-subbody">Read documentation</p>

</div>

<div class="column large-3 medium-6 small-12">

```

        <a href="/videos/graphics-games/" class="block text-
center">
            <figure class="router-icon router-icon-videos"
data-hires-status="pending"></figure>
            <p><strong>Videos</strong></p>
            <p class="typography-subbody">Learn about
the latest in Apple technologies presented at WWDC and other events.</p>
            <p class="typography-subbody"><span
class="block-link more">Watch videos</span></p>
            </a>
        </div>
        <div class="column large-3 medium-6 small-12">
            <a href="/forums/tags/realitykit/" class="block text-
center">
                <figure class="router-icon router-icon-forums"
data-hires-status="pending"></figure>
                <p><strong>Forums</strong></p>
                <p class="typography-subbody">Ask questions
and discuss development topics with Apple engineers and
fellow developers.</p>
                <p class="typography-subbody"><span
class="block-link more">View forums</span></p>
                </a>
            </div>
        </div>
    </div>
</aside>

    <link rel="stylesheet" href="/assets/styles/footer.dist.css?
41172203193">
    <footer id="footer" class="footer" role="contentinfo" aria-labelledby="footer-
label">
        <div class="footer-content">
            <h2 class="footer-label" id="footer-label">Developer Footer</h2>
            <section class="footer-sosumi">
                <ul>
                    <li>* Processing time will vary based on object complexity
and other factors.</li>
                </ul>
            </section>
            <developer-breadcrumbs style="display: block;">

                <nav class="footer-breadcrumbs" aria-label="Breadcrumbs"><a
href="https://www.apple.com/" class="home footer-breadcrumbs-home"><span
class="footer-breadcrumbs-home-icon" aria-hidden="true" data-hires-
status="pending"></span><span class="footer-breadcrumbs-home-
label">Apple</span></a><div class="footer-breadcrumbs-path"><ol
class="footer-breadcrumbs-list"><li class="footer-breadcrumbs-item"><a
href="/">Developer</a></li><li class="footer-breadcrumbs-item"><a
href="/augmented-reality/">Augmented Reality</a></li><li class="footer-
breadcrumbs-item">RealityKit Overview</li></ol></div></nav></developer-
breadcrumbs>

```

```

        <nav class="footer-directory" aria-label="Apple Developer
Directory" role="navigation">
        <!--googleoff: all-->
        <div class="footer-directory-column">
            <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-platform">
            <div class="footer-directory-column-section">
                <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-platform">
                    <h3 class="footer-directory-column-section-
title">Platforms</h3>
                    </label>
                    <a href="#footer-directory-column-section-state-platform"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
                    <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
                    <ul class="footer-directory-column-section-list">
                        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/ios/">iOS</a></li>
                        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/ipados/">iPadOS</a></li>
                        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/macos/">macOS</a></li>
                        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/tvos/">tvOS</a></li>
                        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/watchos/">watchOS</a></li>
                    </ul>
                </div>

            <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-tools">
            <div class="footer-directory-column-section">
                <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-tools">
                    <h3 class="footer-directory-column-section-
title">Tools</h3>
                    </label>
                    <a href="#footer-directory-column-section-state-tools"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
                    <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
                    <ul class="footer-directory-column-section-list">
                        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/swift/">Swift</a></li>
                        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/swiftui/">SwiftUI</a></li>

```

```

        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/swift-playgrounds/">Swift
Playgrounds</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/testflight/">TestFlight</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/xcode/">Xcode</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/xcode-cloud/">Xcode
Cloud</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/sf-symbols/">SF
Symbols</a></li>
    </ul>
</div>
</div>

```

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<div class="footer-directory-column">
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-topics">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-topics">
            <h3 class="footer-directory-column-section-
title">Topics & Technologies</h3>
            </label>
            <a href="#footer-directory-column-section-state-topics"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
            <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
            <ul class="footer-directory-column-section-list">
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/accessibility/">Accessibility</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/accessories/">Accessories</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-extensions/">App
Extensions</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-store/">App
Store</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/audio/">Audio &
Video</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/augmented-
reality/">Augmented Reality</a></li>
            </ul>
        </div>
    </div>

```

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        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/business/">Business</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/design/">Design</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/distribute/">Distribution</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/education/">Education</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/fonts/">Fonts</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/games/">Games</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/health-fitness/">Health
& Fitness</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/in-app-purchase/">In-App
Purchase</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/localization/">Localization</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/maps/">Maps &
Location</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/machine-learning/">Machine
Learning</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/security/">Security</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/safari/">Safari &
Web</a></li>
    </ul>
</div>
</div>

```

```

<div class="footer-directory-column">
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-resources">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-resources">
            <h3 class="footer-directory-column-section-
title">Resources</h3>
            </label>
            <a href="#footer-directory-column-section-state-resources"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>

```

```

        <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/documentation/">Documentation</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/learn/curriculum/">Curriculum</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/download/">Downloads</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="https://developer.apple.com/forums/">Forums</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/videos/">Videos</a></li>
        </ul>
    </div>

```

```

        <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-support">
        <div class="footer-directory-column-section">
            <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-support">
                <h3 class="footer-directory-column-section-
title">Support</h3>
            </label>
            <a href="#footer-directory-column-section-state-support"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
            <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
            <ul class="footer-directory-column-section-list">
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/support/articles/">Support
Articles</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/contact/">Contact
Us</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/bug-reporting/">Bug
Reporting</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/system-status/">System
Status</a></li>
            </ul>
        </div>

```

```

        <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-account">

```

```

        <div class="footer-directory-column-section">
            <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-account">
                <h3 class="footer-directory-column-section-
title">Account</h3>
            </label>
            <a href="#footer-directory-column-section-state-account"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
            <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
            <ul class="footer-directory-column-section-list">
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/account/">Apple
Developer</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="https://appstoreconnect.apple.com/">App Store Connect</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/account/ios/certificate/">Certificates, IDs, & Profiles</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="https://feedbackassistant.apple.com/">Feedback Assistant</a></li>
            </ul>
        </div>
    </div>

```

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    <div class="footer-directory-column">
        <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-programs">
        <div class="footer-directory-column-section">
            <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-programs">
                <h3 class="footer-directory-column-section-
title">Programs</h3>
            </label>
            <a href="#footer-directory-column-section-state-programs"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
            <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
            <ul class="footer-directory-column-section-list">
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/">Apple Developer
Program</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/enterprise/">Apple
Developer Enterprise Program</a></li>
            </ul>
        </div>
    </div>

```

```
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-store/small-business-
program/">App Store Small Business Program</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="https://mfi.apple.com/">MFi
Program</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/news-
partner/">News Partner Program</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/video-
partner/">Video Partner Program</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/security-bounty/">Security
Bounty Program</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/security-research-
device/">Security Research Device Program</a></li>
    </ul>
</div>
```

```
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-events">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-events">
            <h3 class="footer-directory-column-section-
title">Events</h3>
        </label>
        <a href="#footer-directory-column-section-state-events"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
        <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/accelerator/">App
Accelerators</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-store/app-store-
awards/">App Store Awards</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/design/awards/">Apple
Design Awards</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/learn/experts/#academies">Apple Developer Academies</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/entrepreneur-
camp/">Entrepreneur Camp</a></li>
```



```

        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/tech-talks/">Tech
Talks</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/wwdc/">WWDC</a></li>
    </ul>
</div>
</div>
<!--googleon: all-->
</nav>
<section class="footer-mini" vocab="http://schema.org/"
typeof="Organization">
    <div class="footer-mini-news">
        <div class="copy">
            To view the latest developer news, visit <a
href="/news/">News and Updates</a>.
        </div>
        <div class="content">
            <div class="color-scheme-toggle" role="radiogroup"
tabindex="0" aria-label="Select a color scheme preference">

                <label data-color-scheme-option="light">

                    <input type="radio" value="light"
autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">

                    <div class="text">Light</div>

                </label>

                <label data-color-scheme-option="dark">

                    <input type="radio" value="dark"
autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">

                    <div class="text">Dark</div>

                </label>

                <label data-color-scheme-option="auto">

                    <input type="radio" value="auto"
autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">

                    <div class="text">Auto</div>

                </label>

            </div>
            <script async="" src="/assets/scripts/color-scheme-
toggle.js"></script>

```

```

        </div>
    </div>
    <link rel="stylesheet" href="/assets/styles/language-dropdown.css?
41172203193">
    <div class="language-dropdown dropdown-container" data-
lang="complete">
        <select class="dropdown" aria-label="Language
Dropdown"><option
value="https://developer.apple.com/augmented-reality/realitykit/">English</
option><option
value="https://developer.apple.com/cn/augmented-reality/realitykit/">□□□□</
option><option
value="https://developer.apple.com/jp/augmented-reality/realitykit/">□□□□</
option><option
value="https://developer.apple.com/kr/augmented-reality/realitykit/">□□□□</
option></select>
        <span class="dropdown-icon icon icon-chevron-down" aria-
hidden="true"></span>
    </div>
    <script async="" src="/assets/scripts/lib/jquery/jquery.language-
dropdown.js?41172203193"></script>
    <div class="footer-mini-legal">
        <div class="footer-mini-legal-copyright">Copyright © 2022 <a
href="https://www.apple.com">Apple Inc.</a> All rights reserved.</div>
        <div class="footer-mini-legal-links">
            <a class="footer-mini-legal-link"
href="https://www.apple.com/legal/internet-services/terms/site.html">Terms of
Use</a>
            <a class="footer-mini-legal-link"
href="https://www.apple.com/legal/privacy/en-ww/">Privacy Policy</a>
            <a class="footer-mini-legal-link"
href="/support/terms/">Agreements and Guidelines</a>
        </div>
    </div>
</section>
</div>
</footer>

</body></html><html xmlns="https://www.w3.org/1999/xhtml" xml:lang="en"
lang="en"><head>
    <link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=SF+Pro&v=2" type="text/css">
    <link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=SF+Pro+Icons&v=1" type="text/css">
    <link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=SF+Mono&v=2" type="text/css">
    <link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=Apple+Icons&v=1" type="text/css">

    <meta charset="utf-8">
    <meta name="Author" content="Apple Inc.">
    <meta name="viewport" content="width=device-width, initial-scale=1,
viewport-fit=cover">
    <link rel="shortcut icon" href="/favicon.ico">

```

```

<link rel="icon" href="/favicon.ico">
<link rel="mask-icon" href="/apple-logo.svg" color="#333333">

<link rel="stylesheet" href="/assets/styles/global.dist.css?41172203193"
type="text/css">

<link rel="stylesheet" href="/assets/styles/localization.css?41172203193"
type="text/css">

<script src="/assets/scripts/lib/jquery/jquery-3.6.0.min.js?41172203193"></
script>
<script src="/assets/scripts/settings.js?41172203193"></script>
<script src="/assets/scripts/language-locales.js?41172203193"></script>
<script src="/assets/scripts/DeveloperBreadcrumbs.js?41172203193"></script>

<script async="" src="/assets/scripts/lib/jquery/jquery.retinate.js?
41172203193"></script>
<script async="" src="/assets/scripts/global.js?41172203193"></script>
<script async="" src="/assets/scripts/global-logout.js?41172203193"></script>

    <title>RoomPlan Overview - Augmented Reality - Apple
Developer</title>
    <meta name="omni_page" content="RoomPlan - Augmented
Reality - (English)">
    <meta name="Description" content="RoomPlan is a new Swift API
that utilizes the camera and LiDAR Scanner on iPhone and iPad to create a 3D
floor plan of a room with characteristics like dimensions and type of furniture
included.">

        <meta property="og:locale" content="en_US">
        <meta property="og:site_name" content="Apple Developer">
        <meta property="og:type" content="website">
        <meta property="og:image"
content="https://developer.apple.com/news/images/og/roomplan-og.jpg">
        <meta property="og:title" content="RoomPlan - Augmented Reality
- Apple Developer">
        <meta property="og:description" content="RoomPlan is a new
Swift API that utilizes the camera and LiDAR Scanner on iPhone and iPad to
create a 3D floor plan of a room with characteristics like dimensions and type of
furniture included.">
        <meta property="og:url"
content="https://developer.apple.com/augmented-reality/roomplan/">

        <meta name="twitter:card" content="summary_large_image">
        <meta name="twitter:image"
content="https://developer.apple.com/news/images/og/roomplan-og-
twitter.jpg">
        <meta name="twitter:description" content="RoomPlan is a new
Swift API that utilizes the camera and LiDAR Scanner on iPhone and iPad to
create a 3D floor plan of a room with characteristics like dimensions and type of
furniture included.">
        <meta name="twitter:title" content="RoomPlan - Augmented
Reality - Apple Developer">

```

```

        <meta name="twitter:url"
content="https://developer.apple.com/augmented-reality/roomplan/">

        <link rel="alternate"
href="https://developer.apple.com/kr/augmented-reality/roomplan/"
hreflang="ko-KR">
        <link rel="alternate"
href="https://developer.apple.com/jp/augmented-reality/roomplan/"
hreflang="ja-JP">
        <link rel="alternate"
href="https://developer.apple.com/cn/augmented-reality/roomplan/"
hreflang="zh-CN">
        <link rel="alternate"
href="https://developer.apple.com/augmented-reality/roomplan/"
hreflang="en">
        <link rel="canonical"
href="https://developer.apple.com/augmented-reality/roomplan/">

        <link rel="stylesheet" href="/augmented-reality/styles/augmented-
reality-alt.css" type="text/css">
        <link rel="stylesheet"
href="/augmented-reality/styles/roomplan.css" type="text/css">
    </head>

    <body id="roomplan" class="dmf" data-color-scheme="light">
        <link rel="stylesheet" href="/assets/styles/globalnav.css?
41172203193" type="text/css">

        <link rel="stylesheet" href="/assets/styles/suggest-lang.css?41172203193"
type="text/css">
        <div id="suggest-lang" class="ribbon hide">
            <div class="ribbon-content-wrapper">
                <div class="ribbon-content row">
                    <div class="column large-12 large-centered">
                        <a id="suggest-closer" class="icon icon-after icon-
reset"></a>
                        <p><a href="#" id="suggest-link" class="ribbon-link
more">View in English</a></p>
                    </div>
                </div>
            </div>
        </div>
        <script src="/assets/scripts/suggest-lang.js?41172203193"></script>
        <aside id="ac-gn-segmentbar" class="ac-gn-segmentbar" lang="en-US"
dir="ltr">
        </aside>
        <input type="checkbox" id="ac-gn-menustate" class="ac-gn-menustate">
        <nav id="ac-globalnav" class="js touch no-windows" role="navigation" aria-
label="Global" data-hires="false" data-analytics-region="global nav" lang="en-
US" dir="ltr" data-www-domain="www.apple.com" data-store-locale="us" data-
store-root-path="/us" data-store-api="/[storefront]/shop/bag/status" data-
search-locale="en_US"
data-search-suggestions-api="/search-services/suggestions/" data-search-

```

```

defaultlinks-api="/search-services/suggestions/defaultlinks/" data-search-
suggestions-enabled="false">
    <div class="ac-gn-content">
        <ul class="ac-gn-header">
            <li class="ac-gn-item ac-gn-menuicon">
                <label class="ac-gn-menuicon-label" for="ac-gn-
menustate" aria-hidden="true">
                    <span class="ac-gn-menuicon-bread ac-gn-
menuicon-bread-top">
                        <span class="ac-gn-menuicon-bread-
crust ac-gn-menuicon-bread-crust-top"></span>
                    </span>
                    <span class="ac-gn-menuicon-bread ac-gn-
menuicon-bread-bottom">
                        <span class="ac-gn-menuicon-bread-
crust ac-gn-menuicon-bread-crust-bottom"></span>
                    </span>
                </label>
                <a href="#ac-gn-menustate" role="button" class="ac-
gn-menuanchor ac-gn-menuanchor-open" id="ac-gn-menuanchor-open">
                    <span class="ac-gn-menuanchor-label">Global
Nav Open Menu</span>
                </a>
                <a href="#" role="button" class="ac-gn-menuanchor
ac-gn-menuanchor-close" id="ac-gn-menuanchor-close">
                    <span class="ac-gn-menuanchor-label">Global
Nav Close Menu</span>
                </a>
            </li>
            <li class="ac-gn-item ac-gn-apple">
                <a class="ac-gn-link ac-gn-link-apple-developer"
href="/" data-analytics-title="appledeveloper home" id="ac-gn-firstfocus-
small">
                    <span class="ac-gn-link-text">Apple
Developer</span>
                </a>
            </li>
        </ul>
        <div class="ac-gn-search-placeholder-container" role="search">
            <div class="ac-gn-search ac-gn-search-small">
                <a id="ac-gn-link-search-small" class="ac-gn-link"
href="/search/" data-analytics-title="search" data-analytics-click="search" data-
analytics-intrapage-link="" aria-label="Search" role="button" aria-
haspopup="true">
                    <div class="ac-gn-search-placeholder-bar">
                        <div class="ac-gn-search-placeholder-
input">
                            <div class="ac-gn-search-
placeholder-input-text" aria-hidden="true">
                                <div class="ac-gn-link-
search ac-gn-search-placeholder-input-icon"></div>
                                <span class="ac-gn-search-
placeholder">Search</span>
                            </div>

```

```

</div>
<div class="ac-gn-searchview-close ac-
gn-searchview-close-small ac-gn-search-placeholder-searchview-close">
    <span class="ac-gn-searchview-
close-cancel" aria-hidden="true">Cancel</span>
</div>
</div>
</a>
</div>
</div>
<ul class="ac-gn-list">
    <li class="ac-gn-item ac-gn-apple">
        <a class="ac-gn-link ac-gn-link-apple-developer"
href="/" data-analytics-title="appledeveloper home" id="ac-gn-firstfocus">
            <span class="ac-gn-link-text">Apple
Developer</span>
        </a>
    </li>
    <li class="ac-gn-item ac-gn-item-menu ac-gn-news">
        <a class="ac-gn-link ac-gn-link-news" href="/news/"
data-analytics-title="news">
            <span class="ac-gn-link-text">News</span>
        </a>
    </li>
    <li class="ac-gn-item ac-gn-item-menu ac-gn-discover">
        <a class="ac-gn-link ac-gn-link-discover"
href="/discover/" data-analytics-title="discover">
            <span
class="ac-gn-link-text">Discover</span>
        </a>
    </li>
    <li class="ac-gn-item ac-gn-item-menu ac-gn-design">
        <a class="ac-gn-link ac-gn-link-design" href="/design/"
data-analytics-title="design">
            <span class="ac-gn-link-text">Design</span>
        </a>
    </li>
    <li class="ac-gn-item ac-gn-item-menu ac-gn-develop">
        <a class="ac-gn-link ac-gn-link-develop"
href="/develop/" data-analytics-title="develop">
            <span class="ac-gn-link-text">Develop</span>
        </a>
    </li>
    <li class="ac-gn-item ac-gn-item-menu ac-gn-distribute">
        <a class="ac-gn-link ac-gn-link-distribute"
href="/distribute/" data-analytics-title="distribute">
            <span
class="ac-gn-link-text">Distribute</span>
        </a>
    </li>
    <li class="ac-gn-item ac-gn-item-menu ac-gn-dsupport">
        <a class="ac-gn-link ac-gn-link-dsupport"
href="/support/" data-analytics-title="dsupport">
            <span class="ac-gn-link-text">Support</span>

```

```

        </a>
    </li>
    <li class="ac-gn-item ac-gn-item-menu ac-gn-account">
        <a class="ac-gn-link ac-gn-link-account"
href="/account/" data-analytics-title="account">
            <span class="ac-gn-link-text">Account</span>
        </a>
    </li>
    <li class="ac-gn-item ac-gn-item-menu ac-gn-search"
role="search">
        <a id="ac-gn-link-search" class="ac-gn-link ac-gn-link-
search" href="/search/" data-analytics-title="search" data-analytics-
click="search" data-analytics-intrapage-link="" aria-label="Search"
role="button" aria-haspopup="true"></a>
    </li>
</ul>
<aside id="ac-gn-searchview" class="ac-gn-searchview"
role="search" data-analytics-region="search">
    <div class="ac-gn-searchview-content">
        <div class="ac-gn-searchview-bar">
            <div class="ac-gn-searchview-bar-wrapper">
                <form id="ac-gn-searchform" class="ac-
gn-searchform" action="/search/" method="get">
                    <div class="ac-gn-searchform-
wrapper">
                        <input id="ac-gn-
searchform-input" class="ac-gn-searchform-input" type="text" name="q" aria-
label="Search" placeholder="Search" autocorrect="off" autocapitalize="off"
autocomplete="off" spellcheck="false" role="combobox" aria-
autocomplete="list" aria-expanded="true" aria-owns="quicklinks suggestions">
                            <button id="ac-gn-
searchform-submit" class="ac-gn-searchform-submit" type="submit"
disabled="" aria-label="Submit Search"></button>
                                <button id="ac-gn-
searchform-reset" class="ac-gn-searchform-reset" type="reset" disabled=""
aria-label="Clear Search">
                                    <span
class="ac-gn-searchform-reset-background"></span>
                                </button>
                            </div>
                        </form>
                        <button id="ac-gn-searchview-close-
small" class="ac-gn-searchview-close ac-gn-searchview-close-small" aria-
label="Cancel Search">
                            <span class="ac-gn-
searchview-close-cancel" aria-hidden="true">
                                Cancel
                            </span>
                        </button>
                    </div>
                </div>
            <div id="ac-gn-searchresults" class="ac-gn-
searchresults" data-string-quicklinks="Quick Links" data-string-
suggestions="Suggested Searches" data-string-noresults="">

```

```

<section class="ac-gn-searchresults-section ac-gn-searchresults-
section-defaultlinks">
  <div class="ac-gn-searchresults-section-wrapper">
    <div class="search-group-
checkbox hidden"><input id="group-input" type="checkbox" name="group-
filter" checked="">Only search within "<span
id="group-search-label"></span>"</div>
    <h3 class="ac-gn-searchresults-header ac-gn-searchresults-
animated">Quick Links</h3>
    <ul class="ac-gn-searchresults-list" id="defaultlinks"
role="listbox">
      <li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a href="https://developer.apple.com/ios/" id="search-group-link-0"
class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">iOS
16</a></li><li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a href="https://developer.apple.com/news/" id="search-group-link-
1" class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">Latest
News</a></li><li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a
href="https://developer.apple.com/documentation/storekit/appstore/
environment/3963900-xcode/" id="search-group-link-2" class="ac-gn-
searchresults-link ac-gn-searchresults-link-defaultlinks">xcode</a></li><li
class="ac-gn-searchresults-item ac-gn-searchresults-animated"><a
href="https://developer.apple.com/xcode/whats-new/" id="search-group-link-3"
class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">What's
included in Xcode</a></li><li class="ac-gn-searchresults-item ac-gn-
searchresults-animated"><a
href="https://developer.apple.com/videos/play/wwdc2022/110345/" id="search-
group-link-4" class="ac-gn-searchresults-link ac-gn-searchresults-link-
defaultlinks">What's new in Endpoint Security</a></li></ul>
    <span role="status" class="ac-gn-searchresults-count" aria-
live="polite">5 Quick Links</span>
  </div>
</section>
</aside>
</div>
  <button id="ac-gn-searchview-close" class="ac-gn-
searchview-close" aria-label="Cancel Search">
    <span class="ac-gn-searchview-close-
wrapper">
      <span class="ac-gn-searchview-close-
left"></span>
      <span class="ac-gn-searchview-close-
right"></span>
    </span>
  </button>
</aside>
</div>
</nav>
<div class="ac-gn-blur"></div>
<div id="ac-gn-curtain" class="ac-gn-curtain"></div>
<div id="ac-gn-placeholder" class="ac-nav-placeholder"></div>
<script src="/assets/scripts/ac-globalnav.built.js?41172203193"></script><div
id="ac-gn-viewport-emitter"> </div>

```



```
<link rel="stylesheet" href="/assets/styles/search.css?41172203193">
<script src="/assets/scripts/search.js?41172203193"></script>
```

```
    <!-- metrics -->
<script>
  /* RSID: */
  var s_account="awdappledeveloper"
</script>
<script src="/assets/metrics/scripts/analytics.js?10202020"></script>
<script>
  s.pageName= AC && AC.Tracking && AC.Tracking.pageName();
  s.channel="www.en.developer"
  s.channel="www.en.developer";
```

```
  /***** DO NOT ALTER ANYTHING BELOW THIS LINE ! *****/
  var s_code=s.t();if(s_code)document.write(s_code)
</script>
<!-- /metrics -->
```

```
    <link rel="stylesheet" property="stylesheet"
href="/assets/styles/localnav.css" type="text/css">
<input type="checkbox" id="localnav-menustate" class="localnav-menustate">
<div id="localnav-sticky-placeholder" class="css-sticky"></div><nav
id="localnav" class="localnav localnav-scrim css-sticky" data-sticky=""
role="navigation">
  <div class="localnav-wrapper">
    <div class="localnav-background"></div>
    <div class="localnav-content">
      <h2 class="localnav-title">
        <a href="/augmented-reality/">Augmented Reality</a>
      </h2>

      <div class="localnav-menu">
        <a href="#localnav-menustate" class="localnav-menucta-anchor
localnav-menucta-anchor-open" id="localnav-menustate-open">
          <span class="localnav-menucta-anchor-label">Open Menu</span>
        </a>
        <a href="#" class="localnav-menucta-anchor localnav-menucta-
anchor-close" id="localnav-menustate-close">
          <span class="localnav-menucta-anchor-label">Close Menu</span>
        </a>
        <div class="localnav-menu-tray">
          <ul class="localnav-menu-items">
            <li class="localnav-menu-item">
              <a href="/augmented-reality/" class="localnav-menu-
link">Overview</a>
            </li>
            <li class="localnav-menu-item">
              <a href="/augmented-reality/arkit/" class="localnav-menu-
link">ARKit</a>
            </li>
            <li class="localnav-menu-item">
```

```

<a href="/augmented-reality/realitykit/" class="localnav-menu-
link">RealityKit</a>
</li>
<li class="localnav-menu-item">
  <a href="/augmented-reality/roomplan/" class="localnav-
menu-link current" aria-disabled="true">RoomPlan</a>
</li>
<li class="localnav-menu-item">
  <a href="/augmented-reality/tools/" class="localnav-menu-
link">AR Creation Tools</a>
</li>
<li class="localnav-menu-item">
  <a href="/augmented-reality/quick-look/" class="localnav-
menu-link">AR Quick Look</a>
</li>
<li class="localnav-menu-item">
  <a href="/augmented-reality/resources/" class="localnav-
menu-link">Resources</a>
</li>
</ul>
</div>
<div class="localnav-actions localnav-actions">
  <div class="localnav-action localnav-action-menucta" aria-
hidden="true">
    <label for="localnav-menustate" class="localnav-menucta">
      <span class="localnav-menucta-chevron"></span>
    </label>
  </div>
</div>
</div>
</div>
</div>
</div>
</div>
<label id="localnav-curtain" for="localnav-menustate"></label>
<script src="/assets/scripts/ac-localnav.built.js"></script><div id="localnav-
viewport-emitter" data-viewport-emitter-dispatch="" data-viewport-emitter-
state="{&quot;viewport&quot;;&quot;small&quot;;&quot;orientation&quot;;&quot;
portrait&quot;;&quot;retina&quot;;true}"></div>
<script type="text/javascript" src="/assets/scripts/localnav.js"></script>

<main id="main" class="main" role="main">
  <div class="ribbon ribbon-blue">
    <div class="ribbon-drop-wrapper">
      <div class="ribbon-content-wrapper">
        <div class="ribbon-content row">
          <div class="column large-centered
large-12">
            <p>
              <a
href="/videos/play/wwdc2022/10127/" class="ribbon-link">Watch “Create
parametric 3D room scans with RoomPlan” <span class="icon icon-after icon-
playcircle nowrap">from WWDC22<span
class="loc-wip-sub"></span></span></a>

```

```

        </p>
      </div>
    </div>
  </div>
</div>
<section class="section section-hero">
  <div class="section-content">
    <div class="row">
      <div class="column large-centered large-
9 small-12 text-center">
        <figure class="icon-roomplan
center" data-hires-status="pending"></figure>
        <h1><span
class="nowrap">Introducing RoomPlan</span></h1>
        <p class="typography-
intro">Powered by ARKit, RoomPlan is a new Swift API that utilizes the camera
and LiDAR Scanner on iPhone and iPad to create a 3D floor plan of a room,
including key characteristics such as dimensions and types
of&nbsp;furniture.</p>
      </div>
    </div>
  </div>
  <div class="section section-video">
    <div class="row">
      <div class="column large-centered large-
12 medium-12 small-12 text-center video-max-width">
        <video id="video" class="video
large-centered" autoplay="" muted="" playsinline="" data-source-fallback-
landscape="/augmented-reality/roomplan/videos/roomplan-large.mp4"
src="/augmented-reality/roomplan/videos/roomplan-large.mp4"></video>
      </div>
    </div>
  </div>
</section>

<section class="section section-discover">
  <div class="section-content">
    <div class="row">
      <div class="row headline-row">
        <div class="column large-8 small-
12 large-centered small-uncentered">
          <h2>Bring surroundings into
your app with&nbsp;RoomPlan</h2>
        </div>
      </div>
      <div class="row">
        <div class="column large-6 small-
12">
          <h4>Engage customers,
streamline workflows</h4>
          <p>Help customers make
more informed decisions by using RoomPlan to create a floor plan of a room

```

directly in your apps, such as real estate, e-commerce, or hospitality apps. These scans can also be the first step in architecture and interior design workflows to help streamline conceptual exploration and planning.

with LiDAR

Real-time scanning

Completely customize your app's user experience and scan guidance, or utilize the built-in coaching UI for optimal scans, visual feedback illustrating real-time scanning progress, and a dollhouse visualization that shows everything in the room that has been recognized.

representation

Parametric

RoomPlan outputs in USD or USDZ file formats that include dimensions of each component recognized in the room, such as walls or cabinets, as well as the type of furniture detected. The dimensions and placement of each individual component can be further adjusted when exported into various USDZ-compatible tools, such as Cinema 4D, Shapr3D, or AutoCAD.

12"

device-ipad-pro-11-space-gray-vert-container device-medium-for-large device-small-for-small

class="device-screen">

media="(max-width: 735px)"
srcset="/augmented-reality/roomplan/images/screen-hero-small_2x.jpg"

media="(max-width: 1068px)"
srcset="/augmented-reality/roomplan/images/screen-hero-medium_2x.jpg"

src="/augmented-reality/roomplan/images/screen-hero-large_2x.jpg"
width="100%" alt="iPad Pro displaying RoomPlan" aria-label="iPad Pro displaying RoomPlan" data-hires-status="pending">

hardware" data-hires-status="pending" style="background-image: url('https://developer.apple.com/assets/elements/hardware/ipad_pro_11_space_gray_vert/small_2x.png?156454');">

href="/assets/styles/router-strip.css" type="text/css">

aside class="section developer-router-links">

```

<div class="section-content">
  <div class="row">
    <div class="column large-centered large-10 small-12 text-
center">
      <h2 class="typography-subsection-
headline">Resources and documentation</h2>
      <p>Download the latest version of Xcode and use
these resources to create AR experiences.</p>
    </div>
  </div>
  <div class="row">
    <div class="column large-3 medium-6 small-12">
      <a href="/download/" class="block text-center">
        <figure class="router-icon router-icon-
download" data-hires-status="pending"></figure>
        <p><strong>SDKs and betas</strong></p>
        <p class="typography-subbody">Download
SDKs and beta operating systems for all Apple platforms.</p>
        <p class="typography-subbody"><span
class="block-link more">View Downloads<span
class="loc-en-only"></span></span></p>
      </a>
    </div>
    <div class="column large-3 medium-6 small-12">
      <a href="/documentation/roomplan" class="block
text-center">
        <figure class="router-icon router-icon-
document" data-hires-status="pending"></figure>
        <p><strong>Documentation</strong></p>
        <p class="typography-subbody">Browse the
latest documentation including API reference, articles, and
sample&nbsp;code.</p>
        <p class="typography-subbody"><span
class="block-link more">Read documentation<span
class="loc-en-only"></span></span></p>
      </a>
    </div>
    <div class="column large-3 medium-6 small-12">
      <a href="/videos/graphics/games/" class="block text-
center">
        <figure class="router-icon router-icon-videos"
data-hires-status="pending"></figure>
        <p><strong>Videos</strong></p>
        <p class="typography-subbody">Learn about
the latest in Apple technologies presented at WWDC and other events.</p>
        <p class="typography-subbody"><span
class="block-link more">Watch videos<span
class="loc-partial-sub"></span></span></p>
      </a>
    </div>
    <div class="column large-3 medium-6 small-12">
      <a href="/forums/tags/room-plan/" class="block text-
center">

```

```

<figure class="router-icon router-icon-forums"
data-hires-status="pending"></figure>
<p><strong>Forums</strong></p>
<p class="typography-subbody">Ask questions
and discuss development topics with Apple engineers and
other&nbsp; developers.</p>
<p class="typography-subbody"><span
class="block-link more">View forums<span
class="loc-en-only"></span></span></p>
</a>
</div>
</div>
</div>
</aside>

```

```

<link rel="stylesheet" href="/assets/styles/footer.dist.css?
41172203193">
<footer id="footer" class="footer" role="contentinfo" aria-labelledby="footer-
label">

```

```

<div class="footer-content">
<h2 class="footer-label" id="footer-label">Developer Footer</h2>
<developer-breadcrumbs style="display: block;">

```

```

<nav class="footer-breadcrumbs" aria-label="Breadcrumbs"><a
href="https://www.apple.com/" class="home footer-breadcrumbs-home"><span
class="footer-breadcrumbs-home-icon" aria-hidden="true" data-hires-
status="pending">□</span><span class="footer-breadcrumbs-home-
label">Apple</span></a><div class="footer-breadcrumbs-path"><ol
class="footer-breadcrumbs-list"><li class="footer-breadcrumbs-item"><a
href="/">Developer</a></li><li class="footer-breadcrumbs-item"><a
href="/augmented-reality/">Augmented Reality</a></li><li class="footer-
breadcrumbs-item">RoomPlan</li></ol></div></nav></developer-
breadcrumbs>

```

```

<nav class="footer-directory" aria-label="Apple Developer
Directory" role="navigation">
<!--googleoff: all-->
<div class="footer-directory-column">
<input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-platform">
<div class="footer-directory-column-section">
<label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-platform">
<h3 class="footer-directory-column-section-
title">Platforms</h3>
</label>
<a href="#footer-directory-column-section-state-platform"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
<a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
<ul class="footer-directory-column-section-list">

```

```
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/ios/">iOS</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/ipados/">iPadOS</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/macos/">macOS</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/tvos/">tvOS</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/watchos/">watchOS</a></li>
    </ul>
</div>
```

```
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-tools">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-tools">
            <h3 class="footer-directory-column-section-
title">Tools</h3>
            </label>
            <a href="#footer-directory-column-section-state-tools"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
            <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
            <ul class="footer-directory-column-section-list">
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/swift/">Swift</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/swiftui/">SwiftUI</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/swift-playgrounds/">Swift
Playgrounds</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/testflight/">TestFlight</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/xcode/">Xcode</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/xcode-cloud/">Xcode
Cloud</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/sf-symbols/">SF
Symbols</a></li>
            </ul>
        </div>
    </div>

<div class="footer-directory-column">
```

```

        <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-topics">
        <div class="footer-directory-column-section">
            <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-topics">
                <h3 class="footer-directory-column-section-
title">Topics & Technologies</h3>
            </label>
            <a href="#footer-directory-column-section-state-topics"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
            <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
            <ul class="footer-directory-column-section-list">
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/accessibility/">Accessibility</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/accessories/">Accessories</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-extensions/">App
Extensions</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-store/">App
Store</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/audio/">Audio &
Video</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/augmented-
reality/">Augmented Reality</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/business/">Business</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/design/">Design</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/distribute/">Distribution</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/education/">Education</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/fonts/">Fonts</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/games/">Games</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/health-fitness/">Health
& Fitness</a></li>
            </ul>
        </div>
    </div>

```



```
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/in-app-purchase/">In-App
Purchase</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/localization/">Localization</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/maps/">Maps &
Location</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/machine-learning/">Machine
Learning</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/security/">Security</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/safari/">Safari &
Web</a></li>
```

```
    </ul>
  </div>
</div>
```

```
  <div class="footer-directory-column">
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-resources">
    <div class="footer-directory-column-section">
      <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-resources">
        <h3 class="footer-directory-column-section-
title">Resources</h3>
      </label>
      <a href="#footer-directory-column-section-state-resources"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
      <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
      <ul class="footer-directory-column-section-list">
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/documentation/">Documentation</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/learn/curriculum/">Curriculum</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/download/">Downloads</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="https://developer.apple.com/forums/">Forums</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/videos/">Videos</a></li>
      </ul>
```

</div>

```
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-support">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-support">
            <h3 class="footer-directory-column-section-
title">Support</h3>
        </label>
        <a href="#footer-directory-column-section-state-support"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
        <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/support/articles/">Support
Articles</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/contact/">Contact
Us</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/bug-reporting/">Bug
Reporting</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/system-status/">System
Status</a></li>
        </ul>
    </div>
```

```
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-account">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-account">
            <h3 class="footer-directory-column-section-
title">Account</h3>
        </label>
        <a href="#footer-directory-column-section-state-account"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
        <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/account/">Apple
Developer</a></li>
```

```

        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="https://appstoreconnect.apple.com/">App Store Connect</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/account/ios/certificate/">Certificates, IDs, & Profiles</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="https://feedbackassistant.apple.com/">Feedback Assistant</a></li>
    </ul>
</div>
</div>

<div class="footer-directory-column">
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-programs">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-programs">
            <h3 class="footer-directory-column-section-
title">Programs</h3>
            </label>
            <a href="#footer-directory-column-section-state-programs"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
            <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
            <ul class="footer-directory-column-section-list">
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/">Apple Developer
Program</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/enterprise/">Apple
Developer Enterprise Program</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-store/small-business-
program/">App Store Small Business Program</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="https://mfi.apple.com/">MFi
Program</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/news-
partner/">News Partner Program</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/video-
partner/">Video Partner Program</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/security-bounty/">Security
Bounty Program</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/security-research-
device/">Security Research Device Program</a></li>

```

```

        </ul>
    </div>

    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-events">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-events">
            <h3 class="footer-directory-column-section-
title">Events</h3>
        </label>
        <a href="#footer-directory-column-section-state-events"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
        <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/accelerator/">App
Accelerators</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-store/app-store-
awards/">App Store Awards</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/design/awards/">Apple
Design Awards</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/learn/experts/#academies">Apple Developer Academies</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/entrepreneur-
camp/">Entrepreneur Camp</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/tech-talks/">Tech
Talks</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/wwdc/">WWDC</a></li>
        </ul>
    </div>
</div>
<!--googleon: all-->
</nav>
<section class="footer-mini" vocab="http://schema.org/"
typeof="Organization">
    <div class="footer-mini-news">
        <div class="copy">
            To view the latest developer news, visit <a
href="/news/">News and Updates</a>.
        </div>
        <div class="content">
            <div class="color-scheme-toggle" role="radiogroup"
tabindex="0" aria-label="Select a color scheme preference">

```

```

        <label data-color-scheme-option="light">
            <input type="radio" value="light"
autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">
            <div class="text">Light</div>
        </label>
        <label data-color-scheme-option="dark">
            <input type="radio" value="dark"
autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">
            <div class="text">Dark</div>
        </label>
        <label data-color-scheme-option="auto">
            <input type="radio" value="auto"
autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">
            <div class="text">Auto</div>
        </label>
    </div>
    <script async="" src="/assets/scripts/color-scheme-
toggle.js"></script>
</div>
</div>
<link rel="stylesheet" href="/assets/styles/language-dropdown.css?
41172203193">
<div class="language-dropdown dropdown-container" data-
lang="complete">
    <select class="dropdown" aria-label="Language
Dropdown"><option
value="https://developer.apple.com/augmented-reality/roomplan/">English</
option><option
value="https://developer.apple.com/cn/augmented-reality/roomplan/">□□□□</
option><option
value="https://developer.apple.com/jp/augmented-reality/roomplan/">□□□</
option><option
value="https://developer.apple.com/kr/augmented-reality/roomplan/">□□□</
option></select>
    <span class="dropdown-icon icon icon-chevrondown" aria-
hidden="true"></span>
</div>

```

```

        <script async="" src="/assets/scripts/lib/jquery/jquery.language-
dropdown.js?41172203193"></script>
        <div class="footer-mini-legal">
            <div class="footer-mini-legal-copyright">Copyright © 2022 <a
href="https://www.apple.com">Apple Inc.</a> All rights reserved.</div>
            <div class="footer-mini-legal-links">
                <a class="footer-mini-legal-link"
href="https://www.apple.com/legal/internet-services/terms/site.html">Terms of
Use</a>
                <a class="footer-mini-legal-link"
href="https://www.apple.com/legal/privacy/en-ww/">Privacy Policy</a>
                <a class="footer-mini-legal-link"
href="/support/terms/">Agreements and Guidelines</a>
            </div>
        </div>
</section>
</div>
</footer>

        <script src="/videos/scripts/hls/hls.min.js"></script>
        <script src="/videos/scripts/hls/rtc.min.js"></script>
        <script src="/augmented-reality/roomplan/scripts/video.js"
type="text/javascript" charset="utf-8"></script>

</body></html>
<html xmlns="https://www.w3.org/1999/xhtml" xml:lang="en"
lang="en"><head>
    <meta charset="utf-8">
    <meta name="Author" content="Apple Inc.">
    <meta name="viewport" content="width=device-width, initial-scale=1,
viewport-fit=cover">
    <link rel="shortcut icon" href="/favicon.ico">
    <link rel="icon" href="/favicon.ico">
    <link rel="mask-icon" href="/apple-logo.svg" color="#333333">

    <link rel="stylesheet" href="/assets/styles/global.dist.css?41172203193"
type="text/css">

    <link rel="stylesheet" href="/assets/styles/localization.css?41172203193"
type="text/css">

    <script src="/assets/scripts/lib/jquery/jquery-3.6.0.min.js?41172203193"></
script>
    <script src="/assets/scripts/settings.js?41172203193"></script>
    <script src="/assets/scripts/language-locales.js?41172203193"></script>
    <script src="/assets/scripts/DeveloperBreadcrumbs.js?41172203193"></script>

    <script async="" src="/assets/scripts/lib/jquery/jquery.retinade.js?
41172203193"></script>
    <script async="" src="/assets/scripts/global.js?41172203193"></script>
    <script async="" src="/assets/scripts/global-logout.js?41172203193"></script>

```

```
<link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=SF+Pro&v=2" type="text/css">
<link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=SF+Pro+Icons&v=1" type="text/css">
<link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=SF+Mono&v=2" type="text/css">
<link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=Apple+Icons&v=1" type="text/css">
```

```
<title>Augmented Reality - Technologies - Human Interface Guidelines -
Design - Apple Developer</title>
```

```
<meta name="omni_page" content="Augmented Reality - Technologies -
Human Interface Guidelines - Design - (English)">
```

```
<meta name="Description" content="Augmented reality (or AR) lets you
deliver immersive, engaging experiences that seamlessly blend virtual objects
with the real world.">
```

```
<meta name="php check" content="4">
```

```
<meta name="search_thumbnail" content="/design/human-
interface-guidelines/images/thumbnails/technologies/augmented-reality-
thumbnail_2x.png">
```

```
<link rel="alternate"
href="https://developer.apple.com/design/human-interface-guidelines/
technologies/augmented-reality/" hreflang="en">
```

```
<link rel="canonical"
href="https://developer.apple.com/design/human-interface-guidelines/
technologies/augmented-reality/">
```

```
<script
src="/design/human-interface-guidelines/scripts/application.js?
58172205193" ></script>
```

```
<script src="/assets/scripts/lib/jquery/jquery.bxslider.min.js?
41172203193" ></script>
```

```
<script src="/design/human-interface-guidelines/scripts/hig-nav.js?
58172205193" ></script>
```

```
<script
src="/design/human-interface-guidelines/scripts/darkModelImages.js?
59202215202" ></script>
```

```
<link rel="stylesheet" type="text/css"
href="/design/human-interface-guidelines/styles/application.css?
14172206193" >
```

```
<link rel="stylesheet" type="text/css" href="/design/human-interface-
guidelines/technologies/augmented-reality/styles/augmented-reality.css?
15172206193" >
```

```
<link rel="stylesheet" type="text/css" href="/design/human-interface-
guidelines/styles/human-interface-guidelines.css?01002216211" >
```

```

<style type="text/css">.helpers-
module_transition {
  transition-duration: 160ms;
  transition-timing-function: cubic-bezier(0.25, 0.46, 0.45, 0.94);
}</style><style type="text/css">.SidenavLine_line {
  position: absolute;
  top: 0;
  left: -1px;
  width: 1px;
  height: 25px;
  background: black;
  will-change: transform;
  transition-property: transform;
}
</style><style type="text/css">.SidenavItem_children {
  margin: 0;
  opacity: 0.6;
}
.SidenavItem_link {
  opacity: 0.6;
  padding: 0.2em 0;
  border-radius: 4px;
  color: #111;
  font-size: 14px;
  font-weight: 600;
  will-change: opacity;
  transition-property: opacity;
}
.SidenavItem_children .SidenavItem_link {
  font-weight: normal;
}
.SidenavItem_active,
.SidenavItem_link:hover {
  opacity: 1;
  text-decoration: none;
}
</style><style type="text/css">
.Sidenav_container {
  position: sticky;
  position: -webkit-sticky;
  top: 52px;
  left: 100px;
  border-left: 1px solid #e3e3e3;
  padding: 0 18px;
  margin: 0 0 1em;
}
.Sidenav_container * {
  display: block;
}
</style></head>
<body data-hignav-item-name="" data-hignav-is-beta="false" id="technologies-
augmented-reality" class="dmf " data-color-scheme="light">

```



```

<link rel="stylesheet" href="/assets/styles/globalnav.css?41172203193"
type="text/css">

<link rel="stylesheet" href="/assets/styles/suggest-lang.css?41172203193"
type="text/css">
<div id="suggest-lang" class="ribbon hide">
  <div class="ribbon-content-wrapper">
    <div class="ribbon-content row">
      <div class="column large-12 large-centered">
        <a id="suggest-closer" class="icon icon-after icon-
reset"></a>
        <p><a href="#" id="suggest-link" class="ribbon-link
more">View in English</a></p>
      </div>
    </div>
  </div>
</div>
<script src="/assets/scripts/suggest-lang.js?41172203193"></script>
<aside id="ac-gn-segmentbar" class="ac-gn-segmentbar" lang="en-US"
dir="ltr">
</aside>
<input type="checkbox" id="ac-gn-menustate" class="ac-gn-menustate">
<nav id="ac-globalnav" class="js touch no-windows" role="navigation" aria-
label="Global" data-hires="false" data-analytics-region="global nav" lang="en-
US" dir="ltr" data-www-domain="www.apple.com" data-store-locale="us" data-
store-root-path="/us" data-store-api="/[storefront]/shop/bag/status" data-
search-locale="en_US"
data-search-suggestions-api="/search-services/suggestions/" data-search-
defaultlinks-api="/search-services/suggestions/defaultlinks/" data-search-
suggestions-enabled="false">
  <div class="ac-gn-content">
    <ul class="ac-gn-header">
      <li class="ac-gn-item ac-gn-menuicon">
        <label class="ac-gn-menuicon-label" for="ac-gn-
menustate" aria-hidden="true">
          <span class="ac-gn-menuicon-bread ac-gn-
menuicon-bread-top">
            <span class="ac-gn-menuicon-bread-
crust ac-gn-menuicon-bread-crust-top"></span>
          </span>
          <span class="ac-gn-menuicon-bread ac-gn-
menuicon-bread-bottom">
            <span class="ac-gn-menuicon-bread-
crust ac-gn-menuicon-bread-crust-bottom"></span>
          </span>
        </label>
        <a href="#ac-gn-menustate" role="button" class="ac-
gn-menuanchor ac-gn-menuanchor-open" id="ac-gn-menuanchor-open">
          <span class="ac-gn-menuanchor-label">Global
Nav Open Menu</span>
        </a>
        <a href="#" role="button" class="ac-gn-menuanchor
ac-gn-menuanchor-close" id="ac-gn-menuanchor-close">

```

```

Nav Close Menu</span>
    <span class="ac-gn-menuanchor-label">Global
    </a>
  </li>
  <li class="ac-gn-item ac-gn-apple">
    <a class="ac-gn-link ac-gn-link-apple-developer"
href="/" data-analytics-title="appledeveloper home" id="ac-gn-firstfocus-
small">
      <span class="ac-gn-link-text">Apple
Developer</span>
    </a>
  </li>
</ul>
<div class="ac-gn-search-placeholder-container" role="search">
  <div class="ac-gn-search ac-gn-search-small">
    <a id="ac-gn-link-search-small" class="ac-gn-link"
href="/search/" data-analytics-title="search" data-analytics-click="search" data-
analytics-intrapage-link="" aria-label="Search" role="button" aria-
haspopup="true">
      <div class="ac-gn-search-placeholder-bar">
        <div class="ac-gn-search-placeholder-
input">
          <div class="ac-gn-search-
placeholder-input-text" aria-hidden="true">
            <div class="ac-gn-link-
search ac-gn-search-placeholder-input-icon"></div>
            <span class="ac-gn-search-
placeholder">Search</span>
          </div>
        </div>
        <div class="ac-gn-searchview-close ac-
gn-searchview-close-small ac-gn-search-placeholder-searchview-close">
          <span class="ac-gn-searchview-
close-cancel" aria-hidden="true">Cancel</span>
        </div>
      </div>
    </a>
  </div>
</div>
<ul class="ac-gn-list">
  <li class="ac-gn-item ac-gn-apple">
    <a class="ac-gn-link ac-gn-link-apple-developer"
href="/" data-analytics-title="appledeveloper home" id="ac-gn-firstfocus">
      <span class="ac-gn-link-text">Apple
Developer</span>
    </a>
  </li>
  <li class="ac-gn-item ac-gn-item-menu ac-gn-news">
    <a class="ac-gn-link ac-gn-link-news" href="/news/"
data-analytics-title="news">
      <span class="ac-gn-link-text">News</span>
    </a>
  </li>
  <li class="ac-gn-item ac-gn-item-menu ac-gn-discover">

```

```

                <a class="ac-gn-link ac-gn-link-discover"
href="/discover/" data-analytics-title="discover">
                    <span
class="ac-gn-link-text">Discover</span>
                </a>
            </li>
            <li class="ac-gn-item ac-gn-item-menu ac-gn-design">
                <a class="ac-gn-link ac-gn-link-design" href="/design/"
data-analytics-title="design">
                    <span class="ac-gn-link-text">Design</span>
                </a>
            </li>
            <li class="ac-gn-item ac-gn-item-menu ac-gn-develop">
                <a class="ac-gn-link ac-gn-link-develop"
href="/develop/" data-analytics-title="develop">
                    <span class="ac-gn-link-text">Develop</span>
                </a>
            </li>
            <li class="ac-gn-item ac-gn-item-menu ac-gn-distribute">
                <a class="ac-gn-link ac-gn-link-distribute"
href="/distribute/" data-analytics-title="distribute">
                    <span
class="ac-gn-link-text">Distribute</span>
                </a>
            </li>
            <li class="ac-gn-item ac-gn-item-menu ac-gn-dsupport">
                <a class="ac-gn-link ac-gn-link-dsupport"
href="/support/" data-analytics-title="dsupport">
                    <span class="ac-gn-link-text">Support</span>
                </a>
            </li>
            <li class="ac-gn-item ac-gn-item-menu ac-gn-account">
                <a class="ac-gn-link ac-gn-link-account"
href="/account/" data-analytics-title="account">
                    <span class="ac-gn-link-text">Account</span>
                </a>
            </li>
            <li class="ac-gn-item ac-gn-item-menu ac-gn-search"
role="search">
                <a id="ac-gn-link-search" class="ac-gn-link ac-gn-link-
search" href="/search/" data-analytics-title="search" data-analytics-
click="search" data-analytics-intrapage-link="" aria-label="Search"
role="button" aria-haspopup="true"></a>
            </li>
        </ul>
        <aside id="ac-gn-searchview" class="ac-gn-searchview"
role="search" data-analytics-region="search">
            <div class="ac-gn-searchview-content">
                <div class="ac-gn-searchview-bar">
                    <div class="ac-gn-searchview-bar-wrapper">
                        <form id="ac-gn-searchform" class="ac-
gn-searchform" action="/search/" method="get">
                            <div class="ac-gn-searchform-
wrapper">

```

```

<input id="ac-gn-
searchform-input" class="ac-gn-searchform-input" type="text" name="q" aria-
label="Search" placeholder="Search" autocorrect="off" autocapitalize="off"
autocomplete="off" spellcheck="false" role="combobox" aria-
autocomplete="list" aria-expanded="true" aria-owns="quicklinks suggestions">
<button id="ac-gn-
searchform-submit" class="ac-gn-searchform-submit" type="submit"
disabled="" aria-label="Submit Search"></button>
<button id="ac-gn-
searchform-reset" class="ac-gn-searchform-reset" type="reset" disabled=""
aria-label="Clear Search">
<span
class="ac-gn-searchform-reset-background"></span>
</button>
</div>
<input type="hidden" id="search-hidden-
input" value="HIG" name="group"></form>
<button id="ac-gn-searchview-close-
small" class="ac-gn-searchview-close ac-gn-searchview-close-small" aria-
label="Cancel Search">
<span class="ac-gn-
searchview-close-cancel" aria-hidden="true">
Cancel
</span>
</button>
</div>
</div>
<aside id="ac-gn-searchresults" class="ac-gn-
searchresults" data-string-quicklinks="Quick Links" data-string-
suggestions="Suggested Searches" data-string-noresults="">
<section class="ac-gn-searchresults-section ac-gn-searchresults-
section-defaultlinks">
<div class="ac-gn-searchresults-section-wrapper">
<div class="search-group-
checkbox"><input id="group-input" type="checkbox" name="group-filter"
checked="" value="HIG">Only search within "<span id="group-search-
label">Human Interface Guidelines</span>"</div>
<h3 class="ac-gn-searchresults-header ac-gn-searchresults-
animated">Quick Links</h3>
<ul class="ac-gn-searchresults-list" id="defaultlinks"
role="listbox">
<li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a href="https://developer.apple.com/ios/" id="search-group-link-0"
class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">iOS
16</a></li><li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a href="https://developer.apple.com/news/" id="search-group-link-
1" class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">Latest
News</a></li><li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a
href="https://developer.apple.com/documentation/storekit/appstore/
environment/3963900-xcode/" id="search-group-link-2" class="ac-gn-
searchresults-link ac-gn-searchresults-link-defaultlinks">xcode</a></li><li
class="ac-gn-searchresults-item ac-gn-searchresults-animated"><a
href="https://developer.apple.com/xcode/whats-new/" id="search-group-link-3"

```

```

class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">What's
included in Xcode</a></li><li class="ac-gn-searchresults-item ac-gn-
searchresults-animated"><a
href="https://developer.apple.com/videos/play/wwdc2022/110345/" id="search-
group-link-4" class="ac-gn-searchresults-link ac-gn-searchresults-link-
defaultlinks">What's new in Endpoint Security</a></li></ul>
    <span role="status" class="ac-gn-searchresults-count" aria-
live="polite">5 Quick Links</span>
</div>
</section>
</aside>
</div>
<button id="ac-gn-searchview-close" class="ac-gn-
searchview-close" aria-label="Cancel Search">
    <span class="ac-gn-searchview-close-
wrapper">
        <span class="ac-gn-searchview-close-
left"></span>
        <span class="ac-gn-searchview-close-
right"></span>
    </span>
</button>
</aside>
</div>
</nav>
<div class="ac-gn-blur"></div>
<div id="ac-gn-curtain" class="ac-gn-curtain"></div>
<div id="ac-gn-placeholder" class="ac-nav-placeholder"></div>
<script src="/assets/scripts/ac-globalnav.built.js?41172203193"></script><div
id="ac-gn-viewport-emitter"> </div>
<link rel="stylesheet" href="/assets/styles/search.css?41172203193">
<script src="/assets/scripts/search.js?41172203193"></script>

    <!-- metrics -->
<script>
    /* RSID: */
    var s_account="awdappledeveloper"
</script>
<script src="/assets/metrics/scripts/analytics.js?10202020"></script>
<script>
    s.pageName= AC && AC.Tracking && AC.Tracking.pageName();
    s.channel="www.en.developer"
    s.channel="www.hig.developer";

    /***** DO NOT ALTER ANYTHING BELOW THIS LINE ! *****/
    var s_code=s.t();if(s_code)document.write(s_code)
</script>
<!-- /metrics -->

    <link rel="stylesheet" property="stylesheet"
href="/assets/styles/localnav.css" type="text/css">
<input type="checkbox" id="localnav-menustate" class="localnav-menustate">

```

```

<div id="localnav-sticky-placeholder" class="css-sticky
localnav-sticking"></div><nav id="localnav" class="localnav localnav-scrim
css-sticky localnav-sticking" data-sticky="" role="navigation">
  <div class="localnav-wrapper">
    <div class="localnav-background"></div>
    <div class="localnav-content">
      <h2 class="localnav-title">
        <a class="ac-ln-title-logo" href="/design/" data-analytics-
title="product index">Human Interface Guidelines</a>
      </h2>

      <div class="localnav-menu">
        <a href="#localnav-menustate" class="localnav-menucta-anchor
localnav-menucta-anchor-open" id="localnav-menustate-open">
          <span class="localnav-menucta-anchor-label">Open Menu</span>
        </a>
        <a href="#" class="localnav-menucta-anchor localnav-menucta-
anchor-close" id="localnav-menustate-close">
          <span class="localnav-menucta-anchor-label">Close Menu</span>
        </a>
        <div class="localnav-menu-tray">
          <div class="dn-container">
            <nav id="dn-mobile" class="dn localnav-
menu-items" role="navigation" aria-label="Local Navigation" data-hires="true">

```

```

              <ul class="dn-list-container"
style="max-height: 1760.5px; transition: max-height 0.2s ease-in-out 0s;">

```

```

        <li class="dn-list-item">
<span
```

```

class="dn-flex">
        <span class="dn-icon dn-icon-platforms"></span>
        <span class="dn-list-title">Platforms</span>
</span>
```

```

              <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```

```

        <li class="dn-list-item">
<a
href="/design/human-interface-guidelines/platforms/overview">
<span
```

```

class="dn-flex">
        <span class="dn-icon dn-icon-overview"
data-hires-status="pending"></span>

```

Overview

<li class="dn-list-item">

href="/design/human-interface-guidelines/platforms/designing-for-ios">
class="dn-flex">
<span

Designing for iOS

<li class="dn-list-item">

href="/design/human-interface-guidelines/platforms/designing-for-ipados">
class="dn-flex">
<span

Designing for iPadOS

<li class="dn-list-item">

href="/design/human-interface-guidelines/platforms/designing-for-macos">
class="dn-flex">
<span

Designing for macOS


```
        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/platforms/designing-for-tvos">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-designing-for-tvos" data-hires-
status="pending"></span>
                <span>Designing for tvOS</span>
            </a>
        </li>
```

```
        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/platforms/designing-for-watchos">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-designing-for-watchos" data-hires-
status="pending"></span>
                <span>Designing for watchOS</span>
            </a>
        </li>
```

```
</ul>
```

```
</li>
```

```
        <li class="dn-list-item">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-foundations"></span>
                <span class="dn-list-title">Foundations</span>
            </span>
            <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```



```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/foundations/overview">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-overview"
data-hires-status="pending"></span>
          <span>Overview</span>
        </span>
      </a>
    </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/foundations/accessibility">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-accessibility" data-hires-
status="pending"></span>
          <span>Accessibility</span>
        </span>
      </a>
    </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/foundations/app-icons">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-app-icons" data-hires-
status="pending"></span>
          <span>App icons</span>
        </span>
      </a>
    </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/foundations/branding">
        <span
class="dn-flex">

```

<span class="dn-icon dn-icon-branding"
data-hires-status="pending">

Branding

<li class="dn-list-item">

href="/design/human-interface-guidelines/foundations/color">

<a

<span

class="dn-flex">

<span class="dn-icon dn-icon-color"
data-hires-status="pending">

Color

<li class="dn-list-item">

href="/design/human-interface-guidelines/foundations/dark-mode">

<a

<span

class="dn-flex">

<span class="dn-icon dn-icon-dark-mode" data-hires-
status="pending">

Dark Mode

<li class="dn-list-item">

href="/design/human-interface-guidelines/foundations/icons">

<a

<span

class="dn-flex">

<span class="dn-icon dn-icon-icons"
data-hires-status="pending">

Icons

<li class="dn-list-item">

 <span
 class="dn-flex">
 <span class="dn-icon dn-icon-images"
 data-hires-status="pending">
 Images

<li class="dn-list-item">

 <span
 class="dn-flex">
 <span class="dn-icon dn-icon-inclusion"
 data-hires-status="pending">
 Inclusion

<li class="dn-list-item">

 <span
 class="dn-flex">
 <span class="dn-icon dn-icon-layout"
 data-hires-status="pending">
 Layout

<li class="dn-list-item">

```




Materials



```

```
- Motion

```

```
- Right to left

```

```
- 

```


SF Symbols

<li class="dn-list-item">

<span

class="dn-flex">

Typography

<li class="dn-list-item">

<span

class="dn-flex">

Patterns

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

<span

class="dn-flex">

Overview

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/accessing-private-data">
class="dn-flex">
<span

Accessing private data

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/drag-and-drop">
class="dn-flex">
<span

Drag and drop

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/entering-data">
class="dn-flex">
<span

Entering data


```
        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/feedback">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-feedback"
data-hires-status="pending"></span>
                <span>Feedback</span>
            </a>
        </li>
```

```
        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/file-management">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-file-management" data-hires-
status="pending"></span>
                <span>File management</span>
            </a>
        </li>
```

```
        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/going-full-screen">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-going-full-screen" data-hires-
status="pending"></span>
                <span>Going full screen</span>
            </a>
        </li>
```

```
        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/launching">
```

```
class="dn-flex">
    <span class="dn-icon dn-icon-launching" data-hires-
status="pending"></span>
    <span>Launching</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/live-viewing-apps">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-live-viewing-apps" data-hires-
status="pending"></span>
        <span>Live-viewing apps</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/loading">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-loading"
data-hires-status="pending"></span>
        <span>Loading</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/managing-accounts">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-managing-accounts" data-hires-
status="pending"></span>
```


Managing accounts

<li class="dn-list-item">

<span

class="dn-flex">

Managing notifications

<li class="dn-list-item">

<span

class="dn-flex">

Modality

<li class="dn-list-item">

<span

class="dn-flex">

Multitasking


```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/patterns/offering-help">
      <span
class="dn-flex">
        <span class="dn-icon dn-icon-offering-help" data-hires-
status="pending"></span>
        <span>Offering help</span>
      </a>
    </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/patterns/onboarding">
      <span
class="dn-flex">
        <span class="dn-icon dn-icon-onboarding" data-hires-
status="pending"></span>
        <span>Onboarding</span>
      </a>
    </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/patterns/playing-audio">
      <span
class="dn-flex">
        <span class="dn-icon dn-icon-playing-audio" data-hires-
status="pending"></span>
        <span>Playing audio</span>
      </a>
    </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/patterns/playing-haptics">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-playing-haptics" data-hires-
status="pending"></span>
    <span>Playing haptics</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/playing-video">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-playing-video" data-hires-
status="pending"></span>
        <span>Playing video</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/printing">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-printing"
data-hires-status="pending"></span>
        <span>Printing</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/ratings-and-reviews">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-ratings-and-reviews" data-hires-
status="pending"></span>
```

Ratings and reviews

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/searching">
class="dn-flex">

<a
<span

<span class="dn-icon dn-icon-searching" data-hires-
status="pending">

Searching

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/settings">
class="dn-flex">

<a
<span

<span class="dn-icon dn-icon-settings"
data-hires-status="pending">

Settings

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/undo-and-redo">
class="dn-flex">

<a
<span

<span class="dn-icon dn-icon-undo-and-redo" data-hires-
status="pending">

Undo and redo


```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/workouts">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-workouts"
data-hires-status="pending"></span>
                    <span>Workouts</span>
                </span>
            </a>
        </li>
    </ul>
</li>

```

```

        <li class="dn-list-item">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-components"></span>
                <span class="dn-list-title">Components</span>
            </span>
            <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```

```

        <li class="dn-list-item dn-list-item-link">
            <a
href="/design/human-interface-guidelines/components/all-components">
                <span class="dn-flex">
                    <span class="dn-icon dn-icon-all-components" data-hires-
status="pending"></span>
                    <span>All components</span>
                </span>
            </a>
        </li>

```

```
<li class="dn-list-item">
    <span
class="dn-flex">
    <span class="dn-icon dn-icon-content"
data-hires-status="pending"></span>
    <span class="dn-list-title">Content</span>
    </span>
    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/components/content/image-views">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-image-views"></span>
            <span>Image views</span>
        </span>
    </a>
    </li>
```

```
    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/components/content/text-views">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-text-views"></span>
            <span>Text views</span>
        </span>
    </a>
    </li>
```

```
    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/components/content/web-views">
        <span
class="dn-flex">
```


Web views

<li class="dn-list-item">

class="dn-flex">

<span

Layout and organization

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

<span

class="dn-flex">

Boxes

<li class="dn-list-item">

<span

class="dn-flex">

Collections

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/layout-and-organization/
column-views">

<span

class="dn-flex">

Column views

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/layout-and-organization/
disclosure-controls">

<span

class="dn-flex">

Disclosure controls

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/layout-and-organization/
labels">

<span

class="dn-flex">

Labels

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/layout-and-organization/
lists-and-tables">

<span

class="dn-flex">

Lists and tables

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/layout-and-organization/
lockups">

<span

class="dn-flex">

Lockups

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/layout-and-organization/
outline-views">

<span

class="dn-flex">

Outline views

<li class="dn-list-item">

```

<a
href="/design/human-interface-guidelines/components/layout-and-organization/
split-views">
<span
class="dn-flex">
  <span class="dn-icon dn-icon-split-views"></span>
  <span>Split views</span>
</span>
</a>
</li>

```

```

<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/components/layout-and-organization/
tab-views">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-tab-views"></span>
      <span>Tab views</span>
    </span>
  </a>
</li>
</ul>
</li>

```

```

<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-menus-and-actions" data-hires-
status="pending"></span>
    <span class="dn-list-title">Menus and actions</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
    <li class="dn-list-item">

```

```




Activity views



```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/components/menus-and-actions/
buttons">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-buttons"></span>
      <span>Buttons</span>
    </span>
  </a>
</li>
```

```

<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/menus-and-actions/
context-menus">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-context-menus"></span>
            <span>Context menus</span>
        </span>
    </a>
</li>

```

```

<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/menus-and-actions/dock-
menus">
    <span
class="dn-flex">

```


Dock menus

<li class="dn-list-item">

<span

class="dn-flex">

Edit menus

<li class="dn-list-item">

<span

class="dn-flex">

Menus

<li class="dn-list-item">

<span

class="dn-flex">

Pop-up buttons

<li class="dn-list-item">

<span

class="dn-flex">

Pull-down buttons

<li class="dn-list-item">

<span

class="dn-flex">

Toolbars

<li class="dn-list-item">

<span

class="dn-flex">

Navigation and search


```

<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

    <li class="dn-list-item">

        <a
href="/design/human-interface-guidelines/components/navigation-and-search/
navigation-bars">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-navigation-bars"></span>
                <span>Navigation bars</span>
            </span>
        </a>
    </li>

    <li class="dn-list-item">

        <a
href="/design/human-interface-guidelines/components/navigation-and-search/
path-controls">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-path-controls"></span>
                <span>Path controls</span>
            </span>
        </a>
    </li>

    <li class="dn-list-item">

        <a
href="/design/human-interface-guidelines/components/navigation-and-search/
search-fields">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-search-fields"></span>
                <span>Search fields</span>
            </span>
        </a>
    </li>

    <li class="dn-list-item">

```

```
                                <a  
href="/design/human-interface-guidelines/components/navigation-and-search/  
sidebars">
```

```
                                <span  
class="dn-flex">
```

```
                                <span class="dn-icon dn-icon-sidebars"></span>
```

```
                                <span>Sidebars</span>
```

```
                                </span>
```

```
                                </a>
```

```
                                </li>
```

```
                                <li class="dn-list-item">
```

```
                                <a  
href="/design/human-interface-guidelines/components/navigation-and-search/  
tab-bars">
```

```
                                <span  
class="dn-flex">
```

```
                                <span class="dn-icon dn-icon-tab-bars"></span>
```

```
                                <span>Tab bars</span>
```

```
                                </span>
```

```
                                </a>
```

```
                                </li>
```

```
                                <li class="dn-list-item">
```

```
                                <a  
href="/design/human-interface-guidelines/components/navigation-and-search/  
token-fields">
```

```
                                <span  
class="dn-flex">
```

```
                                <span class="dn-icon dn-icon-token-fields"></span>
```

```
                                <span>Token fields</span>
```

```
                                </span>
```

```
                                </a>
```

```
                                </li>
```

```
                                </ul>
```

```
                                </li>
```

```

    <li class="dn-list-item">
class="dn-flex">
    <span class="dn-icon dn-icon-presentation" data-hires-
status="pending"></span>
    <span class="dn-list-title">Presentation</span>
</span>

```

```

    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```

```

    <li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/presentation/action-
sheets">
    <span
class="dn-flex">
    <span class="dn-icon dn-icon-action-sheets"></span>
    <span>Action sheets</span>
    </span>
    </a>
</li>

```

```

    <li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/presentation/alerts">
    <span
class="dn-flex">
    <span class="dn-icon dn-icon-alerts"></span>
    <span>Alerts</span>
    </span>
    </a>
</li>

```

```

    <li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/presentation/page-
controls">
    <span
class="dn-flex">

```


Page controls

<li class="dn-list-item">

<span

class="dn-flex">

Panels

<li class="dn-list-item">

<span

class="dn-flex">

Popovers

<li class="dn-list-item">

<span

class="dn-flex">

Scroll views


```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/presentation/sheets">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-sheets"></span>
                    <span>Sheets</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/presentation/windows">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-windows"></span>
                    <span>Windows</span>
                </span>
            </a>
        </li>

```

```

    </ul>

```

```

</li>

```

```

        <li class="dn-list-item">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-selection-and-input" data-hires-
status="pending"></span>
                <span class="dn-list-title">Selection and input</span>
            </span>

```

```

            <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```

```

        <li class="dn-list-item">

```


Image wells

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/selection-and-input/
onscreen-keyboards">

<span

class="dn-flex">

Onscreen keyboards

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/selection-and-input/
pickers">

<span

class="dn-flex">

Pickers

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/selection-and-input/
segmented-controls">

<span

class="dn-flex">

Segmented controls

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/selection-and-input/
sliders">

<span

class="dn-flex">

Sliders

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/selection-and-input/
steppers">

<span

class="dn-flex">

Steppers

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/selection-and-input/text-
fields">

<span

class="dn-flex">

Text fields

<li class="dn-list-item">

```

                                <a
href="/design/human-interface-guidelines/components/selection-and-input/
toggles">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-toggles"></span>
                                <span>Toggles</span>
                                </span>
                                </a>
                                </li>
                                </ul>
                                </li>

```

```

                                <li class="dn-list-item">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-status"
data-hires-status="pending"></span>
                                <span class="dn-list-title">Status</span>
                                </span>

```

```

                                <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```

```

                                <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/components/status/activity-rings">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-activity-rings"></span>
                                <span>Activity rings</span>
                                </span>
                                </a>
                                </li>

```

```

                                <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/components/status/level-indicators">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-level-indicators"></span>
    <span>Level indicators</span>
    </span>
</li>
</a>
```

```

    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/components/status/progress-
indicators">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-progress-indicators"></span>
                <span>Progress indicators</span>
            </span>
        </a>
    </li>
```

```
</ul>
```

```
</li>
```

```

    <li class="dn-list-item">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-system-experiences" data-hires-
status="pending"></span>
            <span class="dn-list-title">System experiences</span>
        </span>
```

```

        <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```

            <li class="dn-list-item">
                <a
href="/design/human-interface-guidelines/components/system-experiences/
complications">
```

```
class="dn-flex">
    <span class="dn-icon dn-icon-complications"></span>
    <span>Complications</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/system-experiences/
home-screen-quick-actions">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-home-screen-quick-actions"></span>
            <span>Home Screen quick actions</span>
            </span>
        </a>
    </li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/system-experiences/the-
menu-bar">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-the-menu-bar"></span>
            <span>The menu bar</span>
            </span>
        </a>
    </li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/system-experiences/
notifications">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-notifications"></span>
            <span>Notifications</span>
```



```

</span>
</a>
</li>
```

```

<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/components/system-experiences/
status-bars">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-status-bars"></span>
      <span>Status bars</span>
    </a>
  </li>
```

```

<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/components/system-experiences/top-
shelf">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-top-shelf"></span>
      <span>Top Shelf</span>
    </a>
  </li>
```

```

<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/components/system-experiences/
watch-faces">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-watch-faces"></span>
      <span>Watch faces</span>
    </a>
  </li>
```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/system-experiences/
widgets">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-widgets"></span>
                    <span>Widgets</span>
                </span>
            </a>
        </li>

```

```
</ul>
```

```
</li>
```

```
</ul>
```

```
</li>
```

```

        <li class="dn-list-item">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-inputs"></span>
                <span class="dn-list-title">Inputs</span>
            </span>

```

```

            <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```

```

                <li class="dn-list-item">
                    <a
href="/design/human-interface-guidelines/inputs/overview">
                        <span
class="dn-flex">
                            <span class="dn-icon dn-icon-overview"
data-hires-status="pending"></span>
                            <span>Overview</span>
                        </span>
                    </a>
                </li>
            </ul>
        </li>

```

```
</a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/inputs/apple-pencil-and-scribble">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-apple-pencil-and-scribble" data-hires-  
status="pending"></span>  
      <span>Apple Pencil and Scribble</span>  
    </span>  
  </a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/inputs/digital-crown">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-digital-crown" data-hires-  
status="pending"></span>  
      <span>Digital Crown</span>  
    </span>  
  </a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/inputs/focus-and-selection">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-focus-and-selection" data-hires-  
status="pending"></span>  
      <span>Focus and selection</span>  
    </span>  
  </a>  
</li>
```

```
<li class="dn-list-item">
```


Pointing devices

- >

>

Remotes

- >

>

Spatial interactions

- >

>

Touch Bar


```
<li class="dn-list-item">
  <a
    href="/design/human-interface-guidelines/inputs/touchscreen-gestures">
    <span
      class="dn-flex">
        <span class="dn-icon dn-icon-touchscreen-gestures" data-hires-
          status="pending"></span>
        <span>Touchscreen gestures</span>
      </span>
    </a>
  </li>
```



```
<li class="dn-list-item dn-icon--active">
  <span
    class="dn-flex">
    <span class="dn-icon dn-icon-technologies dn-list-item--active dn-icon--
      active"></span>
    <span class="dn-list-title dn-list-item--active dn-icon--
      active">Technologies</span>
    </span>
    <ul class="dn-list-container dn--
      expanded" style="position: relative; visibility: unset; max-height: 955px;
      transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item dn-list-item-link">
  <a
    href="/design/human-interface-guidelines/technologies/all-technologies">
    <span class="dn-flex">
      <span class="dn-icon dn-icon-all-technologies" data-hires-
        status="pending"></span>
```

```
<span>All technologies</span>
</span>
</li> </a>

<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-airplay"
data-hires-status="pending"></span>
    <span class="dn-list-title">AirPlay</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/technologies/airplay/introduction">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-introduction"></span>
          <span>Introduction</span>
        </span>
      </a>
    </li>

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/technologies/airplay/icons">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-icons"
data-hires-status="pending"></span>
          <span>Icons</span>
        </span>
      </a>
    </li>
```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/airplay/editorial">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-editorial"></span>
                    <span>Editorial</span>
                </a>
            </li>
        </ul>
    </li>

```

```

    <li class="dn-list-item dn-list-item-link">
        <a
href="/design/human-interface-guidelines/technologies/always-on">
            <span class="dn-flex">
                <span class="dn-icon dn-icon-always-on" data-hires-
status="pending"></span>
                <span>Always On</span>
            </span>
        </a>
    </li>

```

```

    <li class="dn-list-item">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-app-clips"
data-hires-status="pending"></span>
            <span class="dn-list-title">App Clips</span>
        </span>
    </li>

```



```

<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

    <li class="dn-list-item">

        <a
href="/design/human-interface-guidelines/technologies/app-clips/introduction">
            <span
class="dn-flex">

                <span class="dn-icon dn-icon-introduction"></span>

                <span>Introduction</span>

            </span>
        </a>
    </li>

```

```

    <li class="dn-list-item">

        <a
href="/design/human-interface-guidelines/technologies/app-clips/experience">
            <span
class="dn-flex">

                <span class="dn-icon dn-icon-experience"></span>

                <span>User experience</span>

            </span>
        </a>
    </li>

```

```

    <li class="dn-list-item">

        <a
href="/design/human-interface-guidelines/technologies/app-clips/app-clip-card">
            <span
class="dn-flex">

                <span class="dn-icon dn-icon-app-clip-card"></span>

                <span>App Clip card</span>

            </span>
        </a>
    </li>

```

```

    <li class="dn-list-item">

        <a
href="/design/human-interface-guidelines/technologies/app-clips/app-clip-
codes">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-app-clip-codes"></span>
    <span>App Clip Codes</span>
    </li>
    </a>
    </span>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/app-clips/printing-
guidelines">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-printing-guidelines"></span>
            <span>Printing guidelines</span>
            </span>
        </a>
    </li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/app-clips/legal-
requirements">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-legal-requirements"></span>
            <span>Legal requirements</span>
            </span>
        </a>
    </li>
```

```
</ul>
```

```
</li>
```

```
<li class="dn-list-item">
    <span
class="dn-flex">
```


Apple Pay

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

<span

Introduction

<li class="dn-list-item">

<span

Offering Apple Pay

<li class="dn-list-item">

<span

Checkout and payment

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/apple-pay/handling-
errors">

<span

class="dn-flex">

Error handling

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/apple-pay/subscriptions-
and-donations">

<span

class="dn-flex">

Subscriptions and donations

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/apple-pay/buttons-and-
marks">

<span

class="dn-flex">

Buttons and marks

<li class="dn-list-item">

```


```

```

<li class="dn-list-item dn-list-item-link dn-list-item--active">

```

```

<li class="dn-list-item">
    <span
class="dn-flex">
    <span class="dn-icon dn-icon-carekit"
data-hires-status="pending"></span>
    <span class="dn-list-title">CareKit</span>
    </span>
    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```



```

<span class="dn-icon dn-icon-user-experience"></span>

<span>User experience</span>
</span>
</a>
</li>

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/technologies/carekit/symbols-and-
branding">
<span
class="dn-flex">
<span class="dn-icon dn-icon-symbols-and-branding"></span>
<span>Symbols and branding</span>
</span>
</a>
</li>

</ul>

</li>

<li class="dn-list-item">
<span
class="dn-flex">
<span class="dn-icon dn-icon-carplay"
data-hires-status="pending"></span>
<span class="dn-list-title">CarPlay</span>
</span>
<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/technologies/carplay/introduction">
<span
class="dn-flex">
<span class="dn-icon dn-icon-introduction"></span>

```

Introduction

<li class="dn-list-item">

href="/design/human-interface-guidelines/technologies/carplay/architecture">
class="dn-flex">
<span

Architecture

<li class="dn-list-item">

href="/design/human-interface-guidelines/technologies/carplay/interaction">
class="dn-flex">
<span

Interaction

<li class="dn-list-item">

href="/design/human-interface-guidelines/technologies/carplay/visual-design">
class="dn-flex">
<span

Visual design

<li class="dn-list-item">


```

                                <a
href="/design/human-interface-guidelines/technologies/carplay/icons-and-
images">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-icons-and-images"></span>
    <span>Icons and images</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/carplay/system-
elements">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-system-elements"></span>
    <span>System elements</span>
                                </span>
                                </a>
                                </li>
                                </ul>
                                </li>

```

```

    <li class="dn-list-item">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-game-center" data-hires-
status="pending"></span>
    <span class="dn-list-title">Game Center</span>
                                </span>
                                <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
    <li class="dn-list-item">

```



```
<span class="dn-icon dn-icon-achievements"></span>

<span>Achievements</span>
</li>
</a>
</span>

<li class="dn-list-item">
  <a
    href="/design/human-interface-guidelines/technologies/game-center/
    leaderboards">
    <span
      class="dn-flex">
        <span class="dn-icon dn-icon-leaderboards"></span>
        <span>Leaderboards</span>
      </span>
    </a>
  </li>

  <li class="dn-list-item">
    <a
      href="/design/human-interface-guidelines/technologies/game-center/
      multiplayer">
        <span
          class="dn-flex">
            <span class="dn-icon dn-icon-multiplayer"></span>
            <span>Multiplayer</span>
          </span>
        </a>
      </li>

      <li class="dn-list-item">
        <a
          href="/design/human-interface-guidelines/technologies/game-center/custom-
          dashboard-links">
            <span
              class="dn-flex">
                <span class="dn-icon dn-icon-custom-dashboard-links"></span>
                <span>Custom dashboard links</span>
              </span>
            </a>
          </li>
```


<li class="dn-list-item dn-list-item-link">

HealthKit

<li class="dn-list-item">

<span

class="dn-flex">

HomeKit

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

<span

class="dn-flex">

Introduction

[Terminology and layout](#)

[Terminology and layout](#)

[Setup](#)

[Siri interactions](#)

```

                                <a
href="/design/human-interface-guidelines/technologies/homekit/custom-
functionality">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-custom-functionality"></span>
    <span>Custom functionality</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/homekit/icons">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-icons"
data-hires-status="pending"></span>
    <span>Icons</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/homekit/editorial">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-editorial"></span>
    <span>Editorial</span>
                                </span>
                                </a>
                                </li>

```

```

</ul>

```

```

</li>

```

```
<li class="dn-list-item dn-list-item-link">
    <a
href="/design/human-interface-guidelines/technologies/icloud">
    <span class="dn-flex">
        <span class="dn-icon dn-icon-icloud"
data-hires-status="pending"></span>
        <span>iCloud</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-in-app-purchase" data-hires-
status="pending"></span>
        <span class="dn-list-title">In-app purchase</span>
    </span>
```

```
        <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/in-app-purchase/
introduction">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-introduction"></span>
                <span>Introduction</span>
            </span>
        </a>
        </li>
```

```
<li class="dn-list-item">
```

```

                                <a
href="/design/human-interface-guidelines/technologies/in-app-purchase/auto-
renewable-subscriptions">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-auto-renewable-subscriptions"></span>
    <span>Auto-renewable subscriptions</span>
                                </span>
                                </a>
                                </li>

```

```
</ul>
```

```
</li>
```

```

<li class="dn-list-item dn-list-item-link">
                                <a
href="/design/human-interface-guidelines/technologies/live-photos">
    <span class="dn-flex">
      <span class="dn-icon dn-icon-live-photos" data-hires-
status="pending"></span>
      <span>Live Photos</span>
    </span>
                                </a>
                                </li>

```

```

<li class="dn-list-item">
                                <span
class="dn-flex">
      <span class="dn-icon dn-icon-mac-catalyst" data-hires-
status="pending"></span>
      <span class="dn-list-title">Mac Catalyst</span>
                                </span>

```

```

                                <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```



```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/
introduction">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-introduction"></span>
                <span>Introduction</span>
            </span>
        </a>
    </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/app-
structure">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-app-structure"></span>
                <span>App structure</span>
            </span>
        </a>
    </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/user-
interaction">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-user-interaction"></span>
                <span>User interaction</span>
            </span>
        </a>
    </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/visual-
design">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-visual-design"></span>
    <span>Visual design</span>
    </span>
</a>
</li>
```

```
    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/mac-
idiom">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-mac-idiom"></span>
                <span>Mac idiom</span>
            </span>
        </a>
    </li>
</ul>
</li>
```

```
    <li class="dn-list-item">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-machine-learning" data-hires-
status="pending"></span>
            <span class="dn-list-title">Machine learning</span>
        </span>
        <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
            <li class="dn-list-item">
                <a
href="/design/human-interface-guidelines/technologies/machine-learning/
introduction">
```

```
class="dn-flex">
    <span class="dn-icon dn-icon-introduction"></span>
    <span>Introduction</span>
    </span>
    </a>
</li>

<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/machine-learning/roles">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-roles"></span>
        <span>Machine learning roles</span>
    </span>
    </a>
</li>

<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/machine-learning/
explicit-feedback">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-explicit-feedback"></span>
        <span>Explicit feedback</span>
    </span>
    </a>
</li>

<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/machine-learning/
implicit-feedback">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-implicit-feedback"></span>
        <span>Implicit feedback</span>
    </span>
    </a>
</li>
```


<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/technologies/machine-learning/
calibration">
<span
class="dn-flex">

Calibration

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/technologies/machine-learning/
corrections">
<span
class="dn-flex">

Corrections

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/technologies/machine-learning/
mistakes">
<span
class="dn-flex">

Mistakes

<li class="dn-list-item">


```

<span class="dn-icon dn-icon-limitations"></span>

<span>Limitations</span>

</a>
</li>
</ul>

</li>

<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-maps"
data-hires-status="pending"></span>

    <span class="dn-list-title">Maps</span>
  </span>

  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/technologies/maps/introduction">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-introduction"></span>

          <span>Introduction</span>
        </span>
      </a>
    </li>

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/technologies/maps/apple-watch-
maps">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-apple-watch-maps"></span>

```



```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
introduction">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-introduction"></span>
        <span>Introduction</span>
    </a>
</li>
```

```

</li>
</a>
</span>
```

```

<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
branding">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-branding"
data-hires-status="pending"></span>
      <span>Branding</span>
    </a>
  </li>
</span>
```

```

<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
buttons">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-buttons"></span>
      <span>Buttons</span>
    </a>
  </li>
</span>
```

```

<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
color">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-color"
data-hires-status="pending"></span>
      <span>Color</span>
    </a>
  </li>
</span>
```



```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
dark-mode">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-dark-mode" data-hires-
status="pending"></span>
                    <span>Dark Mode</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
logo">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-logo"></span>
                    <span>Logo</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
message-bubble-content">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-message-bubble-content"></span>
                    <span>Message bubble content</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">

```

```




















```

```


```

```
- 

```

```
- 

```

```
</li> </a>
```

```
<li class="dn-list-item dn-list-item-link">  
  
  <a  
    href="/design/human-interface-guidelines/technologies/researchkit">  
      <span class="dn-flex">  
        <span class="dn-icon dn-icon-researchkit" data-hires-  
status="pending"></span>  
        <span>ResearchKit</span>  
      </span>  
    </a>  
  </li>
```

```
<li class="dn-list-item dn-list-item-link">  
  
  <a  
    href="/design/human-interface-guidelines/technologies/shareplay">  
      <span class="dn-flex">  
        <span class="dn-icon dn-icon-shareplay" data-hires-  
status="pending"></span>  
        <span>SharePlay</span>  
      </span>  
    </a>  
  </li>
```

```
<li class="dn-list-item dn-list-item-link">  
  
  <a  
    href="/design/human-interface-guidelines/technologies/shazamkit">  
      <span class="dn-flex">
```


ShazamKit

<li class="dn-list-item">

class="dn-flex"> <span

Sign in with Apple

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

class="dn-flex"> <span

Introduction

<li class="dn-list-item">

class="dn-flex"> <span

Data management


```

</li>
</a>
</li>

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/technologies/sign-in-with-apple/
buttons">
<span
class="dn-flex">
<span class="dn-icon dn-icon-buttons"></span>
<span>Buttons</span>
</span>
</a>
</li>

</ul>

</li>

<li class="dn-list-item">
<span
class="dn-flex">
<span class="dn-icon dn-icon-siri" data-hires-status="pending"></span>
<span class="dn-list-title">Siri</span>
</span>
<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/technologies/siri/introduction">
<span
class="dn-flex">
<span class="dn-icon dn-icon-introduction"></span>
<span>Introduction</span>
</span>
</a>
</li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/siri/system-intents">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-system-intents"></span>
                    <span>System intents</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/siri/custom-intents">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-custom-intents"></span>
                    <span>Custom intents</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/siri/shortcuts-and-
suggestions">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-shortcuts-and-suggestions"></span>
                    <span>Shortcuts and suggestions</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/siri/editorial-guidelines">
                <span
class="dn-flex">

```


Editorial

<li class="dn-list-item dn-list-item-link">

Tap to Pay on iPhone

<li class="dn-list-item">

<span

class="dn-flex">

Wallet

<ul class="dn-list-container"

style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">


```
class="dn-flex">
    <span class="dn-icon dn-icon-introduction"></span>
    <span>Introduction</span>
    </span>
</a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/wallet/designing-
passes">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-designing-passes"></span>
            <span>Designing passes</span>
            </span>
        </a>
    </li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/wallet/designing-order-
tracking">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-designing-order-tracking"></span>
            <span>Designing order tracking</span>
            </span>
        </a>
    </li>
```

```
</ul>
```

```
</li>
```

```
</ul>
```

```
</li>
```



```

        </ul>

        </nav>

    </div>

    <ul class="localnav-menu-items">
    <li class="localnav-menu-item">
        <a href="/design/" class="localnav-menu-link">Overview</a>
    </li>
    <li class="localnav-menu-item">
        <a href="/design/whats-new/" class="localnav-menu-
link">What's New</a>
    </li>
    <li class="localnav-menu-item">
        <a
href="/design/human-interface-guidelines/guidelines/overview" class="localnav-
menu-link">Guidelines</a>
    </li>
    <li class="localnav-menu-item">
        <a href="/design/awards/" class="localnav-menu-link">Design
Awards</a>
    </li>
    <li class="localnav-menu-item">
        <a href="/videos/design/" class="localnav-menu-
link">Videos</a>
    </li>
    <li class="localnav-menu-item">
        <a href="/design/resources/" class="localnav-menu-
link">Resources</a>
    </li>
    </ul>
    </div>
    <div class="localnav-actions">
        <div class="localnav-action localnav-action-menucta" aria-
hidden="true">
            <label for="localnav-menustate" class="localnav-menucta">
                <span class="localnav-menucta-chevron"></span>
            </label>
        </div>
    </div>

    </div>
    </div>
    </div>
</nav>
<label id="localnav-curtain" for="localnav-menustate"></label>
<script src="/assets/scripts/ac-localnav.built.js"></script><div id="localnav-
viewport-emitter" data-viewport-emitter-dispatch="" data-viewport-emitter-
state="{&quot;viewport&quot;;&quot;small&quot;;&quot;orientation&quot;;&quot;
t;portrait&quot;;&quot;retina&quot;;true}"></div>
<script type="text/javascript" src="/assets/scripts/localnav.js"></script>

    <main id="main" class="main main-hig" role="main">

```

```

        <!-- HIG content -->
        <section class="section section-hig-container" id="section-hig-
container">
            <div id="grid-spacer"></div>
            <div class="section-content">
                <div class="row row-hig-container" id="row-hig-
container">

                    <!-- Side navigation -->
                    <div class="column dn-container small-hide"
style="align-self: flex-start;">
                        <nav id="dn" class="dn"
role="navigation" aria-label="Local Navigation" data-hires="true">

                            <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

                                <li class="dn-list-item">
                                    <span
class="dn-flex">
                                        <span class="dn-icon dn-icon-platforms"></span>
                                        <span class="dn-list-title">Platforms</span>
                                    </span>

                                    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

                                        <li class="dn-list-item">
                                            <a
href="/design/human-interface-guidelines/platforms/overview">
                                                <span
class="dn-flex">
                                                    <span class="dn-icon dn-icon-overview"
data-hires-status="pending"></span>
                                                    <span>Overview</span>
                                                </span>
                                            </a>
                                        </li>

                                        <li class="dn-list-item">
                                            <a
href="/design/human-interface-guidelines/platforms/designing-for-ios">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-designing-for-ios" data-hires-
status="pending"></span>
    <span>Designing for iOS</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/platforms/designing-for-ipados">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-designing-for-ipados" data-hires-
status="pending"></span>
        <span>Designing for iPadOS</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/platforms/designing-for-macos">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-designing-for-macos" data-hires-
status="pending"></span>
        <span>Designing for macOS</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/platforms/designing-for-tvos">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-designing-for-tvos" data-hires-
status="pending"></span>
```

```
<span>Designing for tvOS</span>
                                </span>
                                </a>
                                </li>

<li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/platforms/designing-for-watchos"
                                <span
class="dn-flex">

    <span class="dn-icon dn-icon-designing-for-watchos" data-hires-
status="pending"></span>

    <span>Designing for watchOS</span>
                                </span>
                                </a>
                                </li>

</ul>

                                </li>
```

```
<li class="dn-list-item">
                                <span
class="dn-flex">

    <span class="dn-icon dn-icon-foundations"></span>

    <span class="dn-list-title">Foundations</span>
                                </span>

                                <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

        <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/foundations/overview">
                                <span
class="dn-flex">

                <span class="dn-icon dn-icon-overview"
data-hires-status="pending"></span>

                <span>Overview</span>
```

```

</li>
</a>
</span>

```

```

<li class="dn-list-item">
  <a
    href="/design/human-interface-guidelines/foundations/accessibility">
    <span
      class="dn-flex">
        <span class="dn-icon dn-icon-accessibility" data-hires-
          status="pending"></span>
        <span>Accessibility</span>
      </span>
    </a>
  </li>

```

```

<li class="dn-list-item">
  <a
    href="/design/human-interface-guidelines/foundations/app-icons">
    <span
      class="dn-flex">
        <span class="dn-icon dn-icon-app-icons" data-hires-
          status="pending"></span>
        <span>App icons</span>
      </span>
    </a>
  </li>

```

```

<li class="dn-list-item">
  <a
    href="/design/human-interface-guidelines/foundations/branding">
    <span
      class="dn-flex">
        <span class="dn-icon dn-icon-branding"
          data-hires-status="pending"></span>
        <span>Branding</span>
      </span>
    </a>
  </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/foundations/color">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-color"
data-hires-status="pending"></span>
          <span>Color</span>
        </span>
      </a>
    </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/foundations/dark-mode">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-dark-mode" data-hires-
status="pending"></span>
          <span>Dark Mode</span>
        </span>
      </a>
    </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/foundations/icons">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-icons"
data-hires-status="pending"></span>
          <span>Icons</span>
        </span>
      </a>
    </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/foundations/images">
        <span
class="dn-flex">

```


Images

<li class="dn-list-item">

class="dn-flex">

<span

Inclusion

<li class="dn-list-item">

class="dn-flex">

<span

Layout

<li class="dn-list-item">

class="dn-flex">

<span

Materials

<li class="dn-list-item">

 <span
 class="dn-flex">
 <span class="dn-icon dn-icon-motion"
 data-hires-status="pending">
 Motion

<li class="dn-list-item">

 <span
 class="dn-flex">
 <span class="dn-icon dn-icon-right-to-left" data-hires-
 status="pending">
 Right to left

<li class="dn-list-item">

 <span
 class="dn-flex">
 <span class="dn-icon dn-icon-sf-symbols" data-hires-
 status="pending">
 SF Symbols

<li class="dn-list-item">


```


```

```

<li class="dn-list-item">
  <span class="dn-flex">
    <span class="dn-icon dn-icon-patterns"></span>
    <span class="dn-list-title">Patterns</span>
      </span>
    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
      <li class="dn-list-item">
        <a href="/design/human-interface-guidelines/patterns/overview">
          <span class="dn-icon dn-icon-overview"
data-hires-status="pending"></span>
            <span>Overview</span>
              </span>
            </a>
          </li>

```

```

    <li class="dn-list-item">
      <a href="/design/human-interface-guidelines/patterns/accessing-private-data">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-accessing-private-data" data-hires-
status="pending"></span>
    <span>Accessing private data</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/drag-and-drop">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-drag-and-drop" data-hires-
status="pending"></span>
        <span>Drag and drop</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/entering-data">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-entering-data" data-hires-
status="pending"></span>
        <span>Entering data</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/feedback">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-feedback"
data-hires-status="pending"></span>
```

Feedback

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/file-management">
class="dn-flex">
<span

<span class="dn-icon dn-icon-file-management" data-hires-
status="pending">

File management

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/going-full-screen">
class="dn-flex">
<span

<span class="dn-icon dn-icon-going-full-screen" data-hires-
status="pending">

Going full screen

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/launching">
class="dn-flex">
<span

<span class="dn-icon dn-icon-launching" data-hires-
status="pending">

Launching


```

        <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/patterns/live-viewing-apps">
                                <span
class="dn-flex">
        <span class="dn-icon dn-icon-live-viewing-apps" data-hires-
status="pending"></span>
        <span>Live-viewing apps</span>
                                </span>
                                </a>
        </li>

```

```

        <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/patterns/loading">
                                <span
class="dn-flex">
        <span class="dn-icon dn-icon-loading"
data-hires-status="pending"></span>
        <span>Loading</span>
                                </span>
                                </a>
        </li>

```

```

        <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/patterns/managing-accounts">
                                <span
class="dn-flex">
        <span class="dn-icon dn-icon-managing-accounts" data-hires-
status="pending"></span>
        <span>Managing accounts</span>
                                </span>
                                </a>
        </li>

```

```

        <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/patterns/managing-notifications">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-managing-notifications" data-hires-
status="pending"></span>
    <span>Managing notifications</span>
    </span>
</a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/modality">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-modality"
data-hires-status="pending"></span>
        <span>Modality</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/multitasking">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-multitasking" data-hires-
status="pending"></span>
        <span>Multitasking</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/offering-help">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-offering-help" data-hires-
status="pending"></span>
```

Offering help

<li class="dn-list-item">

class="dn-flex">

<span

<span class="dn-icon dn-icon-onboarding" data-hires-
status="pending">

Onboarding

<li class="dn-list-item">

class="dn-flex">

<span

<span class="dn-icon dn-icon-playing-audio" data-hires-
status="pending">

Playing audio

<li class="dn-list-item">

class="dn-flex">

<span

<span class="dn-icon dn-icon-playing-haptics" data-hires-
status="pending">

Playing haptics


```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/playing-video">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-playing-video" data-hires-
status="pending"></span>
                <span>Playing video</span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/printing">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-printing"
data-hires-status="pending"></span>
                <span>Printing</span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/ratings-and-reviews">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-ratings-and-reviews" data-hires-
status="pending"></span>
                <span>Ratings and reviews</span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/searching">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-searching" data-hires-
status="pending"></span>
    <span>Searching</span>
</li>
</a>
</span>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/settings">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-settings"
data-hires-status="pending"></span>
        <span>Settings</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/undo-and-redo">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-undo-and-redo" data-hires-
status="pending"></span>
        <span>Undo and redo</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/workouts">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-workouts"
data-hires-status="pending"></span>
```



```

<span>Workouts</span>
</a>
</li>
</ul>
</li>

<li class="dn-list-item">
  class="dn-flex">
    <span class="dn-icon dn-icon-components"></span>
    <span class="dn-list-title">Components</span>
    <ul class="dn-list-container"
  style="transition: max-height 0.2s ease-in-out 0s;">
    <li class="dn-list-item dn-list-item-link">
      <a
      href="/design/human-interface-guidelines/components/all-components">
        <span class="dn-flex">
          <span class="dn-icon dn-icon-all-components" data-hires-
            status="pending"></span>
          <span>All components</span>
        </span>
      </a>
    </li>

    <li class="dn-list-item">
      class="dn-flex">

```

<span class="dn-icon dn-icon-content"
data-hires-status="pending">

Content


```
<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item">
```

```

<a
href="/design/human-interface-guidelines/components/content/image-views">
<span
class="dn-flex">

```

Image views


```
<li class="dn-list-item">
```

```


```

Text views


```
<li class="dn-list-item">
```

```


```


`Web views`


```
<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-layout-and-organization" data-hires-
status="pending"></span>
    <span class="dn-list-title">Layout and organization</span>
    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
  <li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/layout-and-organization/
boxes">
      <span
class="dn-flex">
        <span class="dn-icon dn-icon-boxes"></span>
        <span>Boxes</span>
      </span>
    </a>
  </li>
```

```
  <li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/layout-and-organization/
collections">
      <span
class="dn-flex">
        <span class="dn-icon dn-icon-collections"></span>
        <span>Collections</span>
      </span>
    </a>
  </li>
```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/layout-and-organization/
column-views">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-column-views"></span>
                    <span>Column views</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/layout-and-organization/
disclosure-controls">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-disclosure-controls"></span>
                    <span>Disclosure controls</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/layout-and-organization/
labels">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-labels"></span>
                    <span>Labels</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/layout-and-organization/
lists-and-tables">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-lists-and-tables"></span>
    <span>Lists and tables</span>
    </span>
</li>
</a>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/layout-and-organization/
lockups">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-lockups"></span>
            <span>Lockups</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/layout-and-organization/
outline-views">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-outline-views"></span>
            <span>Outline views</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/layout-and-organization/
split-views">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-split-views"></span>
            <span>Split views</span>
```

```

</span>
</a>
</li>

<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/components/layout-and-organization/
tab-views">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-tab-views"></span>
      <span>Tab views</span>
    </a>
  </li>
</ul>
</li>
```

```

<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-menus-and-actions" data-hires-
status="pending"></span>
    <span class="dn-list-title">Menus and actions</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/components/menus-and-actions/
activity-views">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-activity-views"></span>
          <span>Activity views</span>
        </span>
      </a>
    </li>
  </ul>
</li>
```


<li class="dn-list-item">
 <a
href="/design/human-interface-guidelines/components/menus-and-actions/
buttons">
 <span
class="dn-flex">

 Buttons

<li class="dn-list-item">
 <a
href="/design/human-interface-guidelines/components/menus-and-actions/
context-menus">
 <span
class="dn-flex">

 Context menus

<li class="dn-list-item">
 <a
href="/design/human-interface-guidelines/components/menus-and-actions/dock-
menus">
 <span
class="dn-flex">

 Dock menus

<li class="dn-list-item">


```
<span class="dn-icon dn-icon-pull-down-buttons"></span>
<span>Pull-down buttons</span>
</span>
</a>
</li>

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/components/menus-and-actions/
toolbars">
<span
class="dn-flex">
<span class="dn-icon dn-icon-toolbars"></span>
<span>Toolbars</span>
</span>
</a>
</li>

</ul>

</li>
```

```
<li class="dn-list-item">
<span
class="dn-flex">
<span class="dn-icon dn-icon-navigation-and-search" data-hires-
status="pending"></span>
<span class="dn-list-title">Navigation and search</span>
</span>
<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/components/navigation-and-search/
navigation-bars">
<span
class="dn-flex">
```


Navigation bars

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/navigation-and-search/
path-controls">

<span

class="dn-flex">

Path controls

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/navigation-and-search/
search-fields">

<span

class="dn-flex">

Search fields

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/navigation-and-search/
sidebars">

<span

class="dn-flex">

Sidebars

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/navigation-and-search/
tab-bars">

<span

class="dn-flex">

Tab bars

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/navigation-and-search/
token-fields">

<span

class="dn-flex">

Token fields

<li class="dn-list-item">

<span

class="dn-flex">

<span class="dn-icon dn-icon-presentation" data-hires-
status="pending">

Presentation


```

<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

    <li class="dn-list-item">

        <a
href="/design/human-interface-guidelines/components/presentation/action-
sheets">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-action-sheets"></span>
                <span>Action sheets</span>
            </span>
        </a>
    </li>

```

```

    <li class="dn-list-item">

        <a
href="/design/human-interface-guidelines/components/presentation/alerts">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-alerts"></span>
                <span>Alerts</span>
            </span>
        </a>
    </li>

```

```

    <li class="dn-list-item">

        <a
href="/design/human-interface-guidelines/components/presentation/page-
controls">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-page-controls"></span>
                <span>Page controls</span>
            </span>
        </a>
    </li>

```

```

    <li class="dn-list-item">

        <a
href="/design/human-interface-guidelines/components/presentation/panels">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-panels"></span>
    <span>Panels</span>
    </span>
</a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/presentation/popovers">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-popovers"></span>
        <span>Popovers</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/presentation/scroll-
views">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-scroll-views"></span>
        <span>Scroll views</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/presentation/sheets">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-sheets"></span>
        <span>Sheets</span>
    </span>
    </a>
```



```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/components/presentation/windows">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-windows"></span>
      <span>Windows</span>
    </span>
  </a>
</li>
```



```
<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-selection-and-input" data-hires-
status="pending"></span>
    <span class="dn-list-title">Selection and input</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/components/selection-and-input/color-
wells">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-color-wells"></span>
          <span>Color wells</span>
        </span>
      </a>
    </li>
```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/selection-and-input/
combo-boxes">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-combo-boxes"></span>
                    <span>Combo boxes</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/selection-and-input/digit-
entry-views">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-digit-entry-views"></span>
                    <span>Digit entry views</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/selection-and-input/
image-wells">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-image-wells"></span>
                    <span>Image wells</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/selection-and-input/
onscreen-keyboards">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-onscreen-keyboards"></span>
    <span>Onscreen keyboards</span>
    </span>
</a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/selection-and-input/
pickers">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-pickers"></span>
            <span>Pickers</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/selection-and-input/
segmented-controls">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-segmented-controls"></span>
            <span>Segmented controls</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/selection-and-input/
sliders">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-sliders"></span>
            <span>Sliders</span>
```



```

</span>
</a>
</li>

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/components/selection-and-input/
steppers">
<span
class="dn-flex">
<span class="dn-icon dn-icon-steppers"></span>
<span>Steppers</span>
</span>
</a>
</li>

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/components/selection-and-input/text-
fields">
<span
class="dn-flex">
<span class="dn-icon dn-icon-text-fields"></span>
<span>Text fields</span>
</span>
</a>
</li>

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/components/selection-and-input/
toggles">
<span
class="dn-flex">
<span class="dn-icon dn-icon-toggles"></span>
<span>Toggles</span>
</span>
</a>
</li>

</ul>
```



```
<li class="dn-list-item">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-status"
data-hires-status="pending"></span>
        <span class="dn-list-title">Status</span>
    </span>
    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/status/activity-rings">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-activity-rings"></span>
                    <span>Activity rings</span>
                </span>
            </a>
        </li>
```

```
        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/status/level-indicators">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-level-indicators"></span>
                    <span>Level indicators</span>
                </span>
            </a>
        </li>
```

```
<li class="dn-list-item">
```

```

<a
href="/design/human-interface-guidelines/components/status/progress-
indicators">
<span
class="dn-flex">
  <span class="dn-icon dn-icon-progress-indicators"></span>
  <span>Progress indicators</span>
</span>
</a>
</li>
</ul>
</li>

```

```

<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-system-experiences" data-hires-
status="pending"></span>
    <span class="dn-list-title">System experiences</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/components/system-experiences/
complications">
      <span
class="dn-flex">
        <span class="dn-icon dn-icon-complications"></span>
        <span>Complications</span>
      </span>
    </a>
    </li>
  </ul>
</li>

```


Status bars

<li class="dn-list-item">

<span

class="dn-flex">

Top Shelf

<li class="dn-list-item">

<span

class="dn-flex">

Watch faces

<li class="dn-list-item">

<span

class="dn-flex">

Widgets


```
<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-inputs"></span>
    <span class="dn-list-title">Inputs</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/inputs/overview">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-overview"
data-hires-status="pending"></span>
          <span>Overview</span>
        </span>
      </a>
    </li>
```

```
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/inputs/apple-pencil-and-scribble">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-apple-pencil-and-scribble" data-hires-
status="pending"></span>
```

Apple Pencil and Scribble

<li class="dn-list-item">

href="/design/human-interface-guidelines/inputs/digital-crown">
class="dn-flex">

<span

Digital Crown

<li class="dn-list-item">

href="/design/human-interface-guidelines/inputs/focus-and-selection">
class="dn-flex">

<span

Focus and selection

<li class="dn-list-item">

href="/design/human-interface-guidelines/inputs/game-controllers">
class="dn-flex">

<span

Game controllers


```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/inputs/gyro-and-accelerometer">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-gyro-and-accelerometer" data-hires-
status="pending"></span>
                    <span>Gyro and accelerometer</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/inputs/keyboards">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-keyboards" data-hires-
status="pending"></span>
                    <span>Keyboards</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/inputs/pointing-devices">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-pointing-devices" data-hires-
status="pending"></span>
                    <span>Pointing devices</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/inputs/remotes">

```



```
class="dn-flex">
    <span class="dn-icon dn-icon-remotes"
data-hires-status="pending"></span>
    <span>Remotes</span>
    </span>
</a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/inputs/spatial-interactions">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-spatial-interactions" data-hires-
status="pending"></span>
        <span>Spatial interactions</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/inputs/touch-bar">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-touch-bar" data-hires-
status="pending"></span>
        <span>Touch Bar</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/inputs/touchscreen-gestures">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-touchscreen-gestures" data-hires-
status="pending"></span>
```

```
<span>Touchscreen gestures</span>
</span>
</a>
</li>
</ul>
</li>
```

```
<li class="dn-list-item dn-icon--active">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-technologies dn-list-item--active dn-icon--
active"></span>
    <span class="dn-list-title dn-list-item--active dn-icon--
active">Technologies</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item dn-list-item-link">
  <a
href="/design/human-interface-guidelines/technologies/all-technologies">
    <span class="dn-flex">
      <span class="dn-icon dn-icon-all-technologies" data-hires-
status="pending"></span>
      <span>All technologies</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <span
class="dn-flex">
```

<span class="dn-icon dn-icon-airplay"
data-hires-status="pending">

AirPlay

<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

class="dn-flex">

<span

Introduction

<li class="dn-list-item">

class="dn-flex">

<span

<span class="dn-icon dn-icon-icons"
data-hires-status="pending">

Icons

<li class="dn-list-item">

class="dn-flex">

<span

Editorial

<li class="dn-list-item dn-list-item-link">

Always On

<li class="dn-list-item">

App Clips

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

Introduction


```
</a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/technologies/app-clips/experience">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-experience"></span>  
      <span>User experience</span>  
    </span>  
  </a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/technologies/app-clips/app-clip-card">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-app-clip-card"></span>  
      <span>App Clip card</span>  
    </span>  
  </a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/technologies/app-clips/app-clip-  
codes">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-app-clip-codes"></span>  
      <span>App Clip Codes</span>  
    </span>  
  </a>  
</li>
```

```
<li class="dn-list-item">
```

```

                                <a
href="/design/human-interface-guidelines/technologies/app-clips/printing-
guidelines">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-printing-guidelines"></span>
    <span>Printing guidelines</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/app-clips/legal-
requirements">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-legal-requirements"></span>
    <span>Legal requirements</span>
                                </span>
                                </a>
                                </li>
                                </ul>
                                </li>

```

```

    <li class="dn-list-item">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-apple-pay" data-hires-
status="pending"></span>
    <span class="dn-list-title">Apple Pay</span>
                                </span>
                                <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
    <li class="dn-list-item">

```

```

                                <a
href="/design/human-interface-guidelines/technologies/apple-pay/introduction">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-introduction"></span>
    <span>Introduction</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/apple-pay/offering-apple-
pay">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-offering-apple-pay"></span>
    <span>Offering Apple Pay</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/apple-pay/checkout-and-
payment">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-checkout-and-payment"></span>
    <span>Checkout and payment</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/apple-pay/handling-
errors">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-handling-errors"></span>

```

Error handling

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/apple-pay/subscriptions-
and-donations">

<span
class="dn-flex">

Subscriptions and donations

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/apple-pay/buttons-and-
marks">

<span
class="dn-flex">

Buttons and marks

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/apple-pay/editorial-
guidelines">

<span
class="dn-flex">

Editorial

<li class="dn-list-item dn-list-item-link dn-list-item--active">

Augmented reality

<li class="dn-list-item">

CareKit

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

Introduction

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/carekit/data-and-
privacy">

<span

class="dn-flex">

Data and privacy

<li class="dn-list-item">

<span

class="dn-flex">

Views

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/carekit/user-
experience">

<span

class="dn-flex">

User experience

<li class="dn-list-item">

```

                                <a
href="/design/human-interface-guidelines/technologies/carekit/symbols-and-
branding">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-symbols-and-branding"></span>
                                <span>Symbols and branding</span>
                                </span>
                                </a>
                                </li>
                                </ul>
                                </li>

```

```

                                <li class="dn-list-item">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-carplay"
data-hires-status="pending"></span>
                                <span class="dn-list-title">CarPlay</span>
                                </span>
                                <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
                                <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/carplay/introduction">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-introduction"></span>
                                <span>Introduction</span>
                                </span>
                                </a>
                                </li>

```

```

                                <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/carplay/architecture">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-architecture"></span>
    <span>Architecture</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/carplay/interaction">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-interaction"></span>
        <span>Interaction</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/carplay/visual-design">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-visual-design"></span>
        <span>Visual design</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/carplay/icons-and-
images">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-icons-and-images"></span>
        <span>Icons and images</span>
    </span>
    </a>
```


<li class="dn-list-item">

System elements

<li class="dn-list-item">

Game Center

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

Introduction


```
        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/game-center/access-
point">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-access-point"></span>
                    <span>Access point</span>
                </span>
            </a>
        </li>
```

```
        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/game-center/
dashboard">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-dashboard"></span>
                    <span>Dashboard</span>
                </span>
            </a>
        </li>
```

```
        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/game-center/
achievements">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-achievements"></span>
                    <span>Achievements</span>
                </span>
            </a>
        </li>
```

```
        <li class="dn-list-item">
```

```

                                <a
href="/design/human-interface-guidelines/technologies/game-center/
leaderboards">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-leaderboards"></span>
                                <span>Leaderboards</span>
                                </span>
                                </a>
                                </li>

```

```

                                <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/game-center/
multiplayer">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-multiplayer"></span>
                                <span>Multiplayer</span>
                                </span>
                                </a>
                                </li>

```

```

                                <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/game-center/custom-
dashboard-links">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-custom-dashboard-links"></span>
                                <span>Custom dashboard links</span>
                                </span>
                                </a>
                                </li>

```

```

                                </ul>

```

```

                                </li>

```

```
<li class="dn-list-item dn-list-item-link">
    <a
href="/design/human-interface-guidelines/technologies/healthkit">
        <span class="dn-flex">
            <span class="dn-icon dn-icon-healthkit"
data-hires-status="pending"></span>
            <span>HealthKit</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-homekit"
data-hires-status="pending"></span>
        <span class="dn-list-title">HomeKit</span>
    </span>
```

```
        <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
            <li class="dn-list-item">
                <a
href="/design/human-interface-guidelines/technologies/homekit/introduction">
                    <span
class="dn-flex">
                        <span class="dn-icon dn-icon-introduction"></span>
                        <span>Introduction</span>
                    </span>
                </a>
            </li>
```

```
<li class="dn-list-item">
```



```

                                <a
href="/design/human-interface-guidelines/technologies/homekit/terminology-
and-layout">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-terminology-and-layout"></span>
    <span>Terminology and layout</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/homekit/setup">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-setup"></span>
    <span>Setup</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/homekit/siri-
interactions">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-siri-interactions"></span>
    <span>Siri interactions</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/homekit/custom-
functionality">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-custom-functionality"></span>

```

Custom functionality


```
<li class="dn-list-item">
```

```


```

```
<span class="dn-icon dn-icon-icons" data-hires-status="pending"></span>
```

Icons


```
<li class="dn-list-item">
```

```


```


Editorial


```
<li class="dn-list-item dn-list-item-link">
```

[](/design/human-interface-guidelines/technologies/icloud)


```

    <span class="dn-icon dn-icon-icloud"
data-hires-status="pending"></span>

    <span>iCloud</span>

</span>

</li> </a>

```

```

<li class="dn-list-item">

    <span class="dn-flex">

        <span class="dn-icon dn-icon-in-app-purchase" data-hires-
status="pending"></span>

        <span class="dn-list-title">In-app purchase</span>

        <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```

```

    <li class="dn-list-item">

        <a
href="/design/human-interface-guidelines/technologies/in-app-purchase/
introduction">

            <span class="dn-flex">

                <span class="dn-icon dn-icon-introduction"></span>

                <span>Introduction</span>

            </span>

        </a>

    </li>

```

```

    <li class="dn-list-item">

        <a
href="/design/human-interface-guidelines/technologies/in-app-purchase/auto-
renewable-subscriptions">

            <span class="dn-flex">

                <span class="dn-icon dn-icon-auto-renewable-subscriptions"></span>

                <span>Auto-renewable subscriptions</span>

            </span>

        </a>
    </li>

```

```

</li>
</ul>
</li>

<li class="dn-list-item dn-list-item-link">
  <a
href="/design/human-interface-guidelines/technologies/live-photos">
    <span class="dn-flex">
      <span class="dn-icon dn-icon-live-photos" data-hires-
status="pending"></span>
      <span>Live Photos</span>
    </span>
  </a>
</li>

<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-mac-catalyst" data-hires-
status="pending"></span>
    <span class="dn-list-title">Mac Catalyst</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/
introduction">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-introduction"></span>

```

Introduction

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/mac-catalyst/app-
structure">

<span
class="dn-flex">

App structure

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/mac-catalyst/user-
interaction">

<span
class="dn-flex">

User interaction

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/mac-catalyst/visual-
design">

<span
class="dn-flex">

Visual design


```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/mac-
idiom">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-mac-idiom"></span>
                    <span>Mac idiom</span>
                </span>
            </a>
        </li>

```

```

    </ul>

```

```

    </li>

```

```

        <li class="dn-list-item">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-machine-learning" data-hires-
status="pending"></span>
                <span class="dn-list-title">Machine learning</span>
            </span>

```

```

            <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```

```

                <li class="dn-list-item">
                    <a
href="/design/human-interface-guidelines/technologies/machine-learning/
introduction">
                        <span
class="dn-flex">
                            <span class="dn-icon dn-icon-introduction"></span>
                            <span>Introduction</span>
                        </span>
                    </a>
                </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/machine-learning/roles">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-roles"></span>
                    <span>Machine learning roles</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/machine-learning/
explicit-feedback">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-explicit-feedback"></span>
                    <span>Explicit feedback</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/machine-learning/
implicit-feedback">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-implicit-feedback"></span>
                    <span>Implicit feedback</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/machine-learning/
calibration">
                <span
class="dn-flex">

```


Calibration

<li class="dn-list-item">

<span

class="dn-flex">

Corrections

<li class="dn-list-item">

<span

class="dn-flex">

Mistakes

<li class="dn-list-item">

<span

class="dn-flex">

Multiple options

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/machine-learning/
confidence">

<span

class="dn-flex">

Confidence

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/machine-learning/
attribution">

<span

class="dn-flex">

Attribution

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/machine-learning/
limitations">

<span

class="dn-flex">

Limitations


```

    <li class="dn-list-item">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-maps"
data-hires-status="pending"></span>
            <span class="dn-list-title">Maps</span>
        </span>
        <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```

```

    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/technologies/maps/introduction">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-introduction"></span>
                <span>Introduction</span>
            </span>
        </a>
    </li>

```

```

    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/technologies/maps/apple-watch-
maps">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-apple-watch-maps"></span>
                <span>Apple Watch maps</span>
            </span>
        </a>
    </li>

```

```

    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/technologies/maps/indoor-maps">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-indoor-maps"></span>
    <span>Indoor maps</span>
    </a>
</li>
</ul>
```

```
<li class="dn-list-item">
    class="dn-flex">
        <span class="dn-icon dn-icon-messages-for-business" data-hires-
        status="pending"></span>
        <span class="dn-list-title">Messages for Business</span>
        <ul class="dn-list-container"
        style="transition: max-height 0.2s ease-in-out 0s;">
```

```
        <li class="dn-list-item">
            <a
            href="/design/human-interface-guidelines/technologies/messages-for-business/
            introduction">
                <span class="dn-icon dn-icon-introduction"></span>
                <span>Introduction</span>
            </a>
        </li>
```

```
        <li class="dn-list-item">
            <a
            href="/design/human-interface-guidelines/technologies/messages-for-business/
            branding">
```

```
class="dn-flex">
    <span class="dn-icon dn-icon-branding"
data-hires-status="pending"></span>
    <span>Branding</span>
    </span>
</a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
buttons">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-buttons"></span>
            <span>Buttons</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
color">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-color"
data-hires-status="pending"></span>
            <span>Color</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
dark-mode">
        <span
class="dn-flex">
```


Dark Mode

<li class="dn-list-item">

<span

class="dn-flex">

Logo

<li class="dn-list-item">

<span

class="dn-flex">

Message bubble content

<li class="dn-list-item">

<span

class="dn-flex">

Screenshots

<li class="dn-list-item dn-list-item-link">

NFC

<li class="dn-list-item dn-list-item-link">

Photo editing

<li class="dn-list-item dn-list-item-link">


```
<span class="dn-flex">
  <span class="dn-icon dn-icon-researchkit" data-hires-
status="pending"></span>
  <span>ResearchKit</span>
</span>
</li> </a>
```

```
<li class="dn-list-item dn-list-item-link">
  <a
href="/design/human-interface-guidelines/technologies/shareplay">
    <span class="dn-flex">
      <span class="dn-icon dn-icon-shareplay" data-hires-
status="pending"></span>
      <span>SharePlay</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item dn-list-item-link">
  <a
href="/design/human-interface-guidelines/technologies/shazamkit">
    <span class="dn-flex">
      <span class="dn-icon dn-icon-shazamkit" data-hires-
status="pending"></span>
      <span>ShazamKit</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-sign-in-with-apple" data-hires-
status="pending"></span>
        <span class="dn-list-title">Sign in with Apple</span>
    </span>
```

```
<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/sign-in-with-apple/
introduction">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-introduction"></span>
            <span>Introduction</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/sign-in-with-apple/data-
management">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-data-management"></span>
            <span>Data management</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/sign-in-with-apple/
buttons">
        <span
class="dn-flex">
```


Buttons

<li class="dn-list-item">

class="dn-flex">

<span

Siri

<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

<span

class="dn-flex">

Introduction

<li class="dn-list-item">

<span

class="dn-flex">

System intents

```

</span>
</a>
</li>

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/technologies/siri/custom-intents">
<span
class="dn-flex">
<span class="dn-icon dn-icon-custom-intents"></span>
<span>Custom intents</span>
</span>
</a>
</li>

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/technologies/siri/shortcuts-and-
suggestions">
<span
class="dn-flex">
<span class="dn-icon dn-icon-shortcuts-and-suggestions"></span>
<span>Shortcuts and suggestions</span>
</span>
</a>
</li>

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/technologies/siri/editorial-guidelines">
<span
class="dn-flex">
<span class="dn-icon dn-icon-editorial-guidelines"></span>
<span>Editorial</span>
</span>
</a>
</li>

</ul>

</li>
```

```
<li class="dn-list-item dn-list-item-link">
    <a
href="/design/human-interface-guidelines/technologies/tap-to-pay-on-iphone">
    <span class="dn-flex">
        <span class="dn-icon dn-icon-tap-to-pay-on-iphone" data-hires-
status="pending"></span>
        <span>Tap to Pay on iPhone</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-wallet"
data-hires-status="pending"></span>
        <span class="dn-list-title">Wallet</span>
    </span>
    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/technologies/wallet/introduction">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-introduction"></span>
            <span>Introduction</span>
        </span>
    </a>
    </li>
```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/wallet/designing-
passes">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-designing-passes"></span>
                    <span>Designing passes</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/wallet/designing-order-
tracking">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-designing-order-tracking"></span>
                    <span>Designing order tracking</span>
                </a>
            </li>

```

```

    </ul>

```

```

    </li>

```

```

</ul>

```

```

</li>

```

```

</ul>

```

```

        </nav>
    </div>

```

```

    <!-- Main content -->
    <div class="column hig-content no-padding-top"
data-hires="true" id="hig-content">
        <div data-sidenav="Augmented
reality"></div>

```

```

<h1 id="augmented-reality">Augmented reality<div class="column hig-right-
nav" id="hig-right-nav">
    <div class="hig-right-nav-content" id="hig-right-nav-
content">
        <div
class="hig-platform-icon-container">
            <p class="lighter hig-platform-header-
text">Supported platforms</p>
            <ul class="row-full no-bullet no-margin">
                <li class="hig-platform-icon">
                    
                </li>
                <li class="hig-platform-icon">
                    
                </li>
                <li class="hig-platform-icon">
                    
                </li>
                <li class="hig-platform-icon">
                    
                </li>
                <li class="hig-platform-icon">
                    
                </li>
            </ul>
        </div>
        <ul
class="Sidenav_container" style="top: 80px;"><div class="SidenavLine_line
helpers-module_transition" style="transform: translateY(0px);"></div> <li><a
href="#" class="SidenavItem_link helpers-module_transition
SidenavItem_active">Augmented reality</a> <!--></li><li><a
href="#Resources" class="SidenavItem_link helpers-
module_transition">Resources</a> <!--></li></ul>
<script src="/assets/scripts/sidenav.built.js?41172203193"></script>
        </div>
    </div></h1>

```

<p>Augmented reality (or AR) lets you deliver immersive, engaging experiences that seamlessly blend virtual objects with the real world.</p>

<p></p>

<p>Using the device's camera to present the physical world onscreen live, your app superimposes three-dimensional virtual objects, creating the illusion that these objects actually exist. Depending on the experiences your app offers, people can reorient the device to explore the objects from different angles, interact with objects using gestures and movement, and even join other people in multiuser AR experiences. For developer guidance, see ARKit.</p>

<p>Offer AR features only on capable devices. If your app's primary purpose is AR, make your app available only to devices that support ARKit. If your app includes features that require specific AR capabilities, or if AR features are optional in your app, don't show people an error if they try to use these features on a device that doesn't support them; instead, simply avoid offering the feature on an unsupported device. For developer guidance, see Verifying device support and user permission.</p>

<h3 id="creating-an-engaging-comfortable-experience">Creating an engaging, comfortable experience</h3>

<p>Let people use the entire display. Devote as much of the screen as possible to displaying the physical world and your app's virtual objects. Avoid cluttering the screen with controls and information that diminish the immersive experience.</p>

<p>Strive for convincing illusions when placing realistic objects. Design detailed 3D assets with lifelike textures to create objects that appear to inhabit the physical environment in which you place them. Using information from ARKit, you can scale objects properly and position them on detected real-world surfaces, reflect environmental lighting conditions and simulate camera grain, cast top-down diffuse object shadows on real-world surfaces, and update visuals as the camera's position changes. To help avoid breaking the illusion you create, make sure your app updates scenes 60 times per second so objects don't appear to jump or flicker.</p>

<p>Consider how virtual objects with reflective surfaces show the environment. Reflections in ARKit are approximations based on the environment captured by the camera. To help maintain the illusion that an AR experience is real, prefer small or coarse reflective surfaces that downplay the effect of these approximations.</p>

<p>Use audio and haptics to enhance the immersive experience. A sound effect or bump sensation is a great way to confirm that a virtual object has made contact with a physical surface or other virtual object. Background music can also help envelop people in the virtual world. For guidance, see Playing audio and Playing haptics.</p>

Minimize text in the environment. Display only the information that people need for your app experience.

If additional information or controls are necessary, consider displaying them in screen space. Content in *screen space* appears fixed to a consistent location either in the virtual world or, less commonly, on the device screen. It's typically easy for people to find and view content in screen space because it remains stationary while the underlying AR environment moves with the device.

Consider using indirect controls when you need to provide persistent controls. *Indirect controls* are not part of the virtual environment — instead, they are 2D controls displayed in screen space. If people need access to persistent controls in your app, consider placing the controls so that people don't have to adjust how they're holding the device to reach them. Also, consider using translucency in an indirect control to help avoid blocking the underlying scene. For example, the Measure app uses screen space to display a mix of translucent and opaque controls that people use to measure objects in the real world.

```
<div class="device-iphone11-container">  
    
  <div class="device-iphone11-frame" alt=""  
data-hires-status="pending"></div>  
</div>
```

Anticipate that people will use your app in a wide variety of real-world environments. People may open your app in a place where there isn't much room to move around or there aren't any large, flat surfaces. Clearly communicate your app's requirements and expectations to people up front to help them understand how their physical environment can affect their AR experience. You might also consider offering different sets of features for use in different environments.

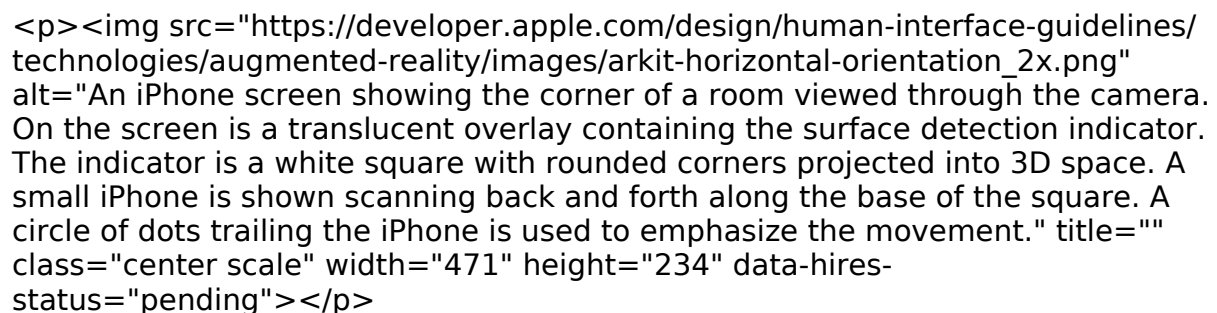
Be mindful of people's comfort. Holding a device at a certain distance or angle for a prolonged period can be fatiguing. To help avoid causing fatigue, consider placing objects at a distance that reduces the need to move the device closer to the object; in a game, consider keeping levels short and intermixed with brief periods of downtime.

If your app encourages people to move, introduce motion gradually. For example, you might not want to make people dodge a virtual projectile as soon as they enter your AR game. Give people time to adapt to the AR experience in your app and then progressively encourage movement.

Be mindful of people's safety. When people are immersed in an AR experience, they're not necessarily aware of their physical surroundings, so making rapid, sweeping, or expansive motions might be

dangerous. Consider ways of making your app safe to operate; for example, a game could avoid encouraging large or sudden movements.</p>

Before people can enjoy an AR experience in your app, they need to move their device in ways that lets ARKit evaluate the surroundings and detect surfaces. In iOS 13 and later, you can use the built-in coaching view to show people what to do and provide feedback during the initialization process. You can also use the coaching view to help people reinitialize AR — a process known as *relocalization* — after an AR experience is interrupted by, for example, people switching briefly to a different app. For guidance on relocalization, see [Handling interruptions](#handling-interruptions); for developer guidance, see [ARCoachingOverlayView](https://developer.apple.com/documentation/arkit/arcoachingoverlayview).

An iPhone screen showing the corner of a room viewed through the camera. On the screen is a translucent overlay containing the surface detection indicator. The indicator is a white square with rounded corners projected into 3D space. A small iPhone is shown scanning back and forth along the base of the square. A circle of dots trailing the iPhone is used to emphasize the movement.

Hide unnecessary app UI while people are using a coaching view. By default, the coaching view appears automatically when initialization or relocalization starts, so you should be prepared to hide unrelated UI to help people focus on the coaching view's instructions.

If necessary, offer a custom coaching experience. Although you can configure the system-provided coaching view to help people provide specific information — such as the detection of a horizontal or vertical plane — you might need additional information or want to use a different visual style. If you want to design a custom coaching experience, use the system-provided coaching view for reference.

Show people when to locate a surface and place an object. You can use the system-provided coaching view to help people find a horizontal or vertical flat surface on which to place an object. After ARKit detects a surface, your app can display a custom visual indicator to show when object placement is possible. You can help people understand how the placed

object will look in the environment by aligning your indicator with the plane of the detected surface.</p>

<div class="row padding-top-small">
<div class="column large-12 small-12">

<p></p>

<p class="typography-caption text-center">App-specific indicator</p>

</div>
</div>

<p>When people place an object, immediately integrate that object into the AR environment. Although surface detection quickly and progressively refines accuracy, it's best to avoid waiting for more accurate data before placing an object. Use the information available to respond instantly when people place an object; then, when surface detection completes, subtly refine the object's position if necessary. For example, if people place an object beyond the bounds of the detected surface, gently nudge the object back onto the surface. For developer guidance on refining an object's position, see ARTrackedRaycast.</p>

<p>Consider guiding people toward offscreen virtual objects. Sometimes, it can be difficult for people to locate an object that's positioned offscreen. When this is the case, you can help people find such objects by offering visual or audible cues. For example, if an object is offscreen to the left, you could display an indicator along the left edge of the screen that guides people to point the camera in that direction.</p>

<p>Avoid trying to precisely align objects with the edges of detected surfaces. In AR, surface boundaries are approximations that may change as people's surroundings are further analyzed.</p>

<p>Incorporate plane classification information to inform object placement. For example, only let people place a virtual piece of furniture on a plane that's classified as “floor,” or require a plane to be classified as “table” in order to place a virtual game board.</p>

<h3 id="designing-intuitive-delightful-object-interactions">Designing intuitive, delightful object interactions</h3>

<p>Let people use direct manipulation to interact with objects when possible. It's more immersive and intuitive when people can interact with onscreen 3D objects by touching them directly, than by using indirect controls in screen space. However, in situations where people are moving around as they use your app, indirect controls can work better.</p>

```
<div class="row padding-top-small no-padding-bottom">
  <div class="column large-6 small-12">
```

```
<p></p>
```

```
<p class="typography-caption text-center">Direct manipulation</p>
```

```
</div>
<div class="column large-6 small-12">
```

```
<p></p>
```

```
<p class="typography-caption text-center">Indirect controls</p>
```

```
</div>
</div>
```

```
<p><strong>Let people directly interact with virtual objects using standard,
familiar gestures.</strong> For example, consider supporting a single-finger
drag gesture for moving objects, and a two-finger rotation gesture for spinning
objects. For guidance, see <a
href="/design/human-interface-guidelines/inputs/touchscreen-
gestures">Touchscreen gestures</a>.</p>
```

```
<p><strong>In general, keep interactions simple.</strong> Touch gestures are
inherently two-dimensional, but an AR experience involves the three dimensions
of the real world. Consider the following approaches to simplifying user
interactions with virtual objects.</p>
```

```
<div class="row no-padding-top no-padding-bottom">
  <div class="column large-6 small-12">
```

```
<p></p>
```

```
<p class="typography-caption text-center">Limit movement to the two-
dimensional surface on which the object rests.</p>
```

```
</div>
<div class="column large-6 small-12">
```

<p></p>

<p class="typography-caption text-center">Limit object rotation to a single axis.</p>

</div>
</div>

<p>Respond to gestures within reasonable proximity of interactive virtual objects. It can be difficult for people to be precise when aiming to touch specific points on objects that are small, thin, or placed at a distance. When your app detects a gesture near an interactive object, it's usually best to assume that people want to affect that object.</p>

<p>Support user-initiated object scaling when it makes sense in your app. For example, if your app lets people explore an imaginary environment, it probably makes sense to support object scaling because your app doesn't need to represent the real world. On the other hand, if your app helps shoppers decide on furniture to buy, letting people scale a chair object doesn't help them visualize how the chair will look in a room.</p>

<div class="note">

<p>TIP Regardless of the purpose of your app, don't use scaling as a way to adjust the distance of an object. If you enlarge a distant object in an effort to make it appear closer, the result is a larger object that still looks far away.</p>

</div>

<p>Be wary of potentially conflicting gestures. A two-finger pinch gesture, for example, is similar to a two-finger rotation gesture. If you implement two similar gestures like this, be sure to test your app and make sure they're interpreted properly.</p>

<p>Strive for virtual object movement that's consistent with the physics of your app's AR environment. People don't necessarily expect an object to move smoothly over a rough or uneven surface, but they do expect objects to remain visible during movement. Aim to keep moving objects attached to real-world surfaces and avoid causing objects to jump or vanish and reappear as people resize, rotate, or move them.</p>

<p>Explore even more engaging methods of interaction. Gestures aren't the only way for people to interact with virtual objects in AR. Your app can use other factors, like motion and proximity, to bring content to life. A game character, for example, could turn its head to look at a person as they walk toward it.</p>

Designing a great multiuser experience

When multiple people share your app's AR experience, each participant maps the environment independently and ARKit automatically merges the maps. For developer guidance, see [isCollaborationEnabled](https://developer.apple.com/documentation/arkit/arworldtrackingconfiguration/3152987-iscollaborationenabled).

Consider enabling people occlusion. If your app supports placing virtual objects behind people who appear in the device's camera feed, enhance the illusion of reality by letting the people occlude the objects. For developer guidance, see [Occluding virtual content with people](https://developer.apple.com/documentation/arkit/occluding_virtual_content_with_people).

When possible, let new participants enter a multiuser AR experience. Unless your app requires all participants to join before the experience begins, consider using implicit map merging to let new people quickly join an ongoing AR experience. For developer guidance, see [isCollaborationEnabled](https://developer.apple.com/documentation/arkit/arworldtrackingconfiguration/3152987-iscollaborationenabled).

Reacting to real-world objects

You can enhance an AR experience by using known images and objects in the real-world environment to trigger the appearance of virtual content. For example, an app that recognizes theater posters for a sci-fi film could cause virtual space ships to emerge from the posters and fly around the environment. Another example is an app for an art museum that presents a virtual tour guide when it recognizes a sculpture. To enable experiences like these, your app provides a set of 2D reference images or 3D reference objects, and ARKit indicates when and where it detects any of these items in the current environment. For developer guidance, see [Recognizing images in an AR experience](https://developer.apple.com/documentation/arkit/recognizing_images_in_an_ar_experience).

When a detected image first disappears, consider delaying the removal of virtual objects that are attached to it. ARKit doesn't track changes to the position or orientation of each detected image. To help prevent virtual objects from flickering, consider waiting up to one second before fading them out or removing them.

Limit the number of reference images in use at one time. Image detection performance works best when ARKit looks for 100 or fewer distinct images in the real-world environment. If you need more than 100 reference images, you can change the set of active reference images based on context. For example, a museum guide app could ask permission to use location services to determine the part of the museum a person is in, and then look only for images displayed in that area.

Limit the number of reference images requiring an accurate position. Updating the position of a reference image requires more resources. Use a tracked image when the image may move in the environment

or when an attached animation or virtual object is small compared to the size of the image.</p>

<p>If you must display instructional text, use approachable terminology. AR is an advanced concept that may be intimidating to some people. To help make it approachable, avoid using technical terms like ARKit, world detection, and tracking. Instead, use friendly, conversational terms that most people will understand.</p>

<table> <thead> <tr> <th>Do</th> <th>Don't</th> </tr> </thead> <tbody> <tr> <td>Unable to find a surface. Try moving to the side or repositioning your phone.</td> <td>Unable to find a plane. Adjust tracking.</td> </tr> <tr> <td>Tap a location to place the [name of object to be placed].</td> <td>Tap a plane to anchor an object.</td> </tr> <tr> <td>Try turning on more lights and moving around.</td> <td>Insufficient features.</td> </tr> <tr> <td>Try moving your phone more slowly.</td> <td>Excessive motion detected.</td> </tr> </tbody> </table> <th data-kind="ghost"></th>	
--	--

<p>In a three-dimensional context, prefer 3D hints. For example, placing a 3D rotation indicator around an object is more intuitive than displaying text-based instructions in a 2D overlay. Avoid displaying textual overlay hints in a 3D context unless people aren't responding to contextual hints.</p>

<div class="row padding-top-small no-padding-bottom">
<div class="column large-6 small-12">

<p></p>

<p class="typography-caption text-center">Prefer a 3D hint in a 3D context.</p>

</div>

<div class="column large-6 small-12">

<p></p>

<p class="typography-caption text-center">If necessary, use a 2D hint in a 3D context.</p>

</div>

</div>

<p>Make important text readable. Use screen space to display text used for critical labels, annotations, and instructions. If you need to display text in 3D space, make sure the text faces people and that you use the same type size regardless of the distance between the text and the labeled object.</p>

<p>If necessary, provide a way to get more information. Design a visual indicator that fits with your app experience to show people that they can tap for more information.</p>

<div class="row padding-top-small">

<div class="column large-12 small-12">

<p></p>

</div>

</div>

<div class="row padding-top-small">

<div class="column large-12 small-12">

<p></p>

</div>
</div>

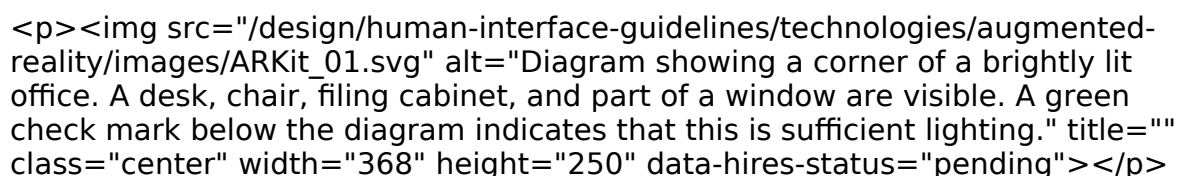
<p>ARKit can't track device position and orientation during an interruption, such as when people briefly switch to another app or accept a phone call. After an interruption ends, previously placed virtual objects are likely to appear in the wrong real-world positions. When you enable relocalization, ARKit attempts to restore those virtual objects to their original real-world positions using new information. For developer guidance, see Managing session lifecycle and tracking quality.</p> <p>Consider using the system-provided coaching view to help people relocalize. During relocalization, ARKit attempts to reconcile its previous state with new observations of the current environment. To enable these observations, you can use the coaching view to help people return the device to its previous position and orientation.</p> <div class="row padding-top-small"> <div class="column large-12 small-12"> <p></p> </div> </div> <p>Consider hiding previously placed virtual objects during relocalization. To avoid flickering or other unpleasant visual effects during relocalization, it can be best to hide virtual objects and redisplay them in their new positions.</p> <p>Minimize interruptions if your app supports both AR and non-AR experiences. One way to avoid interruptions is by embedding a non-AR experience within an AR experience so that people can handle the task without exiting and re-entering AR. For example, if your app helps people decide on a piece of furniture to purchase by placing the item in a room, you might let them change the upholstery without leaving the AR experience.</p>

Allow people to cancel relocalization. If people don't position and orient their device near where it was before an interruption, relocalization continues indefinitely without success. If coaching people to resume their session isn't successful, consider providing a reset button or other way to restart the AR experience.

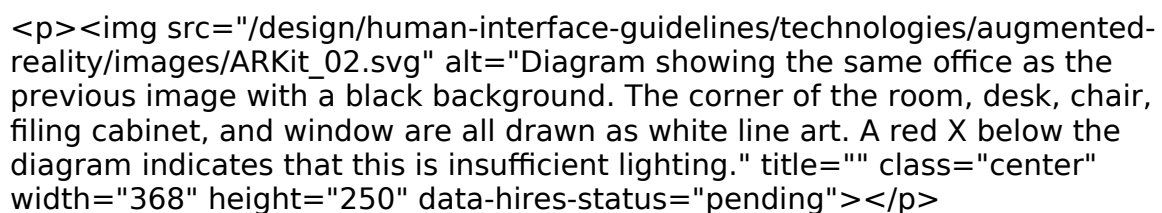
Indicate when the front-facing camera is unable to track a face for more than about half a second. Use a visual indicator to indicate that the camera can no longer track the person's face. If you need to provide text instructions in this situation, keep them to a minimum.

Suggesting ways to resolve problems

Let people reset the experience if it doesn't meet their expectations. Don't force people to wait for conditions to improve or struggle with object placement. Give them a way to start over again and see if they have better results.

A diagram showing a corner of a brightly lit office. A desk, chair, filing cabinet, and part of a window are visible. A green check mark below the diagram indicates that this is sufficient lighting.

Sufficient lighting

A diagram showing the same office as the previous image with a black background. The corner of the room, desk, chair, filing cabinet, and window are all drawn as white line art. A red X below the diagram indicates that this is insufficient lighting.

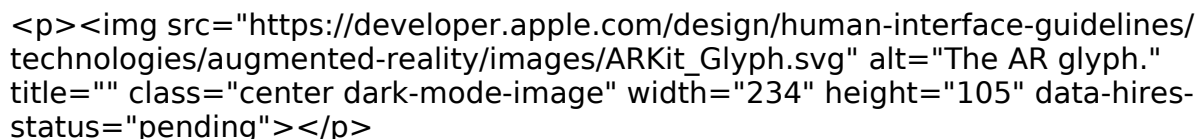
Insufficient lighting

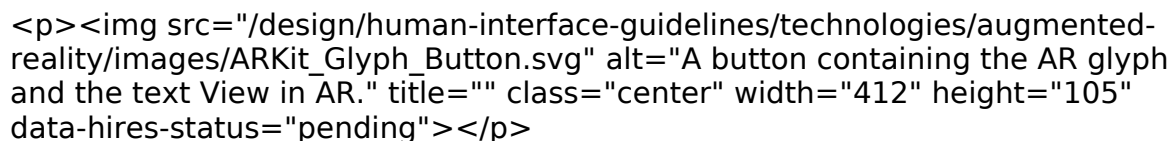
Suggest possible fixes if problems occur. Analysis of the real-world environment and surface detection can fail or take too long for a variety of reasons — insufficient light, an overly reflective surface, a surface without enough detail, or too much camera motion. If your app is notified of these problems, use straightforward, friendly language to offer suggestions for resolving them.

Problem	Possible suggestion
Insufficient features detected.	Try turning on more lights and moving around.
Excessive motion detected.	Try moving your phone slower.
Surface detection takes too long.	Try moving around, turning on more lights, and making sure your phone is pointed at a sufficiently textured surface.

AR icon

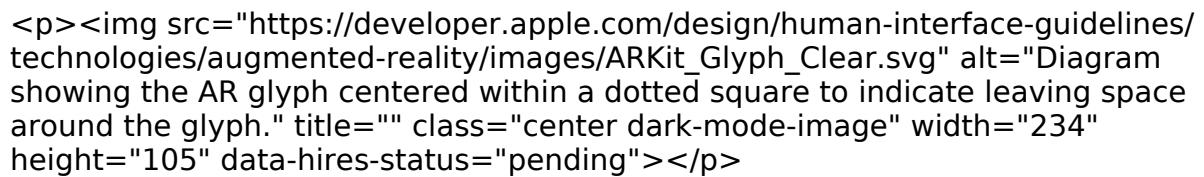
Apps can display an AR icon in controls that launch ARKit-based experiences. You can download this icon in [Resources](/design/resources/#ios-apps).

The AR glyph.

A button containing the AR glyph and the text View in AR.

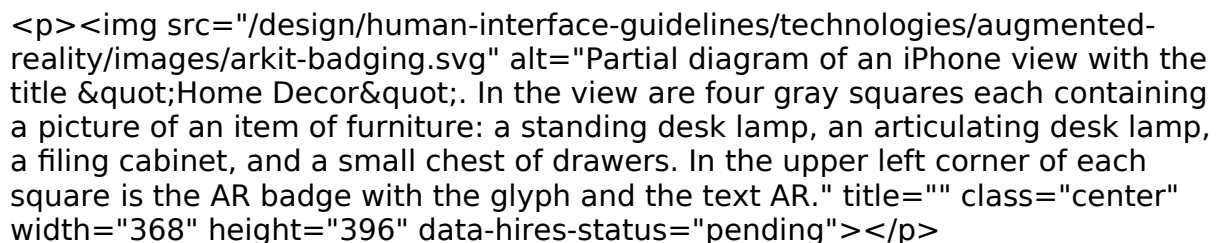
Use the AR glyph as intended. The glyph should be used strictly for initiating an ARKit-based experience. Never alter the glyph (other than adjusting its size and color), use it for other purposes, or use it in conjunction with AR experiences not created using ARKit.

Maintain minimum clear space. The minimum amount of clear space required around an AR glyph is 10% of the glyph's height. Don't let other elements infringe on this space or occlude the glyph in any way.

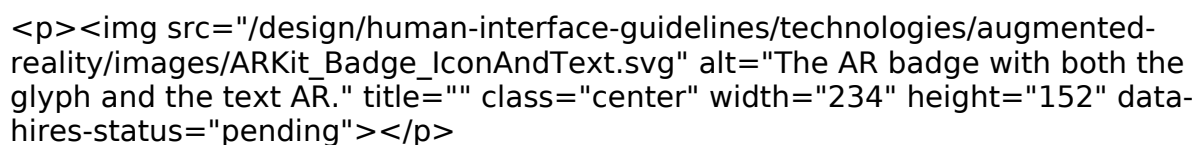
A diagram showing a central AR glyph (a small square with a dot) centered within a larger dotted square. This illustrates the required clear space around the glyph. The diagram is titled "Diagram showing the AR glyph centered within a dotted square to indicate leaving space around the glyph."

AR badges

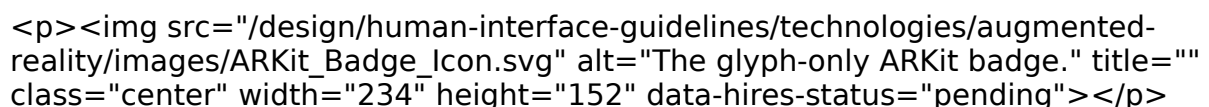
Apps that include collections of products or other objects can use badging to identify specific items that can be viewed in AR using ARKit. For example, a department store app might use a badge to mark furniture that people can preview in their home before making a purchase.

A partial diagram of an iPhone view titled "Home Decor". It shows four gray squares, each containing a different piece of furniture: a standing desk lamp, an articulating desk lamp, a filing cabinet, and a small chest of drawers. In the upper left corner of each square is an AR badge consisting of a small square with a dot (the glyph) and the text "AR".

Use the AR badges as intended and don't alter them. You can download AR badges, available in collapsed and expanded form, in [Resources](/design/resources/#ios-apps). Use these images exclusively to identify products or other objects that can be viewed in AR using ARKit. Never alter the badges, change their color, use them for other purposes, or use them in conjunction with AR experiences not created with ARKit.

The AR badge with both the glyph and the text "AR". It consists of a small square with a dot (the glyph) and the text "AR" to its right.

AR badge

The glyph-only ARKit badge. It consists of a small square with a dot (the glyph).

Glyph-only AR badge

Prefer the AR badge to the glyph-only badge. In general, use the glyph-only badge for constrained spaces that can't accommodate the AR badge. Both badges work well at their default size.

Use badging only when your app contains a mixture of objects that can be viewed in AR and objects that cannot. If all objects in your app can be viewed in AR, then badging is redundant.

Keep badge placement consistent and clear. A badge looks best when displayed in one corner of an object's photo. Always place it in the same corner and make sure it's large enough to be seen clearly (but not so large that it occludes important detail in the photo).

Maintain minimum clear space. The minimum amount of clear space required around an AR badge is 10% of the badge's height. Other elements shouldn't infringe on this space and occlude the badge in any way.

```
<div class="row no-padding-top">
  <div class="column large-6 small-12">
```

```
<p></p>
```

```
</div>
  <div class="column large-6 small-12">
```

```
<p></p>
```

```
</div>
</div>
```

```
<!-- Resources -->
```

```
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    <h2 id="Resources" data-
sidenav="">Resources</h2>
```

```
  <h4>Related</h4>
  <ul class="no-bullet no-margin-
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```

```
    <li><a
href="/design/human-interface-guidelines/patterns/playing-haptics">Playing
haptics</a></li>
```

Touchscreen gestures

Apple Design Resources

<h4>Developer documentation</h4>

<ul class="no-bullet no-margin-left">

ARKit

<h4>Videos</h4>

<ul class="no-bullet no-margin-left video-grid">

<p class="video-grid-title">Qualities of great AR experiences</p>
<p class="video-grid-detail">WWDC22</p>

<p class="video-grid-title">Explore ARKit 5</p>
<p class="video-grid-detail">WWDC21</p>

</div>

</div>

</div>

</div>

</section>

</main>

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Playgrounds</a></li>
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Extensions</a></li>
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            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/design/">Design</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/distribute/">Distribution</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/education/">Education</a></li>

```

```

        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/fonts/">Fonts</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/games/">Games</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/health-fitness/">Health
& Fitness</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/in-app-purchase/">In-App
Purchase</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/localization/">Localization</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/maps/">Maps &
Location</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/machine-learning/">Machine
Learning</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/security/">Security</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/safari/">Safari &
Web</a></li>
    </ul>
</div>
</div>

<div class="footer-directory-column">
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-resources">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-resources">
            <h3 class="footer-directory-column-section-
title">Resources</h3>
            </label>
            <a href="#footer-directory-column-section-state-resources"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
            <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
            <ul class="footer-directory-column-section-list">
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/documentation/">Documentation</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/learn/curriculum/">Curriculum</a></li>

```



```
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/download/">Downloads</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="https://developer.apple.com/forums/">Forums</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/videos/">Videos</a></li>
    </ul>
</div>
```

```
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-support">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-support">
            <h3 class="footer-directory-column-section-
title">Support</h3>
        </label>
        <a href="#footer-directory-column-section-state-support"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
        <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/support/articles/">Support
Articles</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/contact/">Contact
Us</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/bug-reporting/">Bug
Reporting</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/system-status/">System
Status</a></li>
        </ul>
    </div>
```

```
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-account">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-account">
            <h3 class="footer-directory-column-section-
title">Account</h3>
        </label>
        <a href="#footer-directory-column-section-state-account"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
```

```

        <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/account/">Apple
Developer</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="https://appstoreconnect.apple.com/">App Store Connect</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/account/ios/certificate/">Certificates, IDs, & Profiles</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="https://feedbackassistant.apple.com/">Feedback Assistant</a></li>
        </ul>
    </div>
</div>

<div class="footer-directory-column">
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-programs">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-programs">
            <h3 class="footer-directory-column-section-
title">Programs</h3>
            </label>
            <a href="#footer-directory-column-section-state-programs"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
            <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
            <ul class="footer-directory-column-section-list">
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/">Apple Developer
Program</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/enterprise/">Apple
Developer Enterprise Program</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-store/small-business-
program/">App Store Small Business Program</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="https://mfi.apple.com/">MFi
Program</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/news-
partner/">News Partner Program</a></li>

```

```

                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/video-
partner/">Video Partner Program</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/security-bounty/">Security
Bounty Program</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/security-research-
device/">Security Research Device Program</a></li>
            </ul>
        </div>

```

```

        <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-events">
        <div class="footer-directory-column-section">
            <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-events">
                <h3 class="footer-directory-column-section-
title">Events</h3>
            </label>
            <a href="#footer-directory-column-section-state-events"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
            <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
            <ul class="footer-directory-column-section-list">
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/accelerator/">App
Accelerators</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-store/app-store-
awards/">App Store Awards</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/design/awards/">Apple
Design Awards</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/learn/experts/#academies">Apple Developer Academies</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/entrepreneur-
camp/">Entrepreneur Camp</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/tech-talks/">Tech
Talks</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/wwdc/">WWDC</a></li>
            </ul>
        </div>
    </div>
    <!--googleon: all-->
</nav>

```

```

    <section class="footer-mini" vocab="http://schema.org/"
typeof="Organization">
    <div class="footer-mini-news">
        <div class="copy">
            To view the latest developer news, visit <a
href="/news/">News and Updates</a>.
        </div>
        <div class="content">
            <div class="color-scheme-toggle" role="radiogroup"
tabindex="0" aria-label="Select a color scheme preference">

                <label data-color-scheme-option="light">

                    <input type="radio" value="light"
autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">

                        <div class="text">Light</div>

                    </label>

                    <label data-color-scheme-option="dark">

                        <input type="radio" value="dark"
autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">

                            <div class="text">Dark</div>

                        </label>

                        <label data-color-scheme-option="auto">

                            <input type="radio" value="auto"
autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">

                                <div class="text">Auto</div>

                            </label>

                        </div>
                    <script async="" src="/assets/scripts/color-scheme-
toggle.js"></script>
                </div>
            </div>
            <link rel="stylesheet" href="/assets/styles/language-dropdown.css?
41172203193">
            <div class="language-dropdown dropdown-container hidden">
                <select class="dropdown" aria-label="Language
Dropdown"></select>
                <span class="dropdown-icon icon icon-chevrondown" aria-
hidden="true"></span>
            </div>

```

```
<script async="" src="/assets/scripts/lib/jquery/jquery.language-  
dropdown.js?41172203193"></script>  
<div class="footer-mini-legal">  
  <div class="footer-mini-legal-copyright">Copyright © 2022 <a  
href="https://www.apple.com">Apple Inc.</a> All rights reserved.</div>  
  <div class="footer-mini-legal-links">  
    <a class="footer-mini-legal-link"  
href="https://www.apple.com/legal/internet-services/terms/site.html">Terms of  
Use</a>  
    <a class="footer-mini-legal-link"  
href="https://www.apple.com/legal/privacy/en-ww/">Privacy Policy</a>  
    <a class="footer-mini-legal-link"  
href="/support/terms/">Agreements and Guidelines</a>  
  </div>  
</div>  
</section>  
</div>  
</footer>
```

```
</body></html><html xmlns="https://www.w3.org/1999/xhtml" xml:lang="en"  
lang="en"><head>  
  <meta charset="utf-8">  
  <meta name="Author" content="Apple Inc.">  
  <meta name="viewport" content="width=device-width, initial-scale=1,  
viewport-fit=cover">  
  <link rel="shortcut icon" href="/favicon.ico">  
  <link rel="icon" href="/favicon.ico">  
  <link rel="mask-icon" href="/apple-logo.svg" color="#333333">  
  
  <link rel="stylesheet" href="/assets/styles/global.dist.css?41172203193"  
type="text/css">  
  
  <link rel="stylesheet" href="/assets/styles/localization.css?41172203193"  
type="text/css">  
  
  <script src="/assets/scripts/lib/jquery/jquery-3.6.0.min.js?41172203193"></  
script>  
  <script src="/assets/scripts/settings.js?41172203193"></script>  
  <script src="/assets/scripts/language-locales.js?41172203193"></script>  
  <script src="/assets/scripts/DeveloperBreadcrumbs.js?41172203193"></script>  
  
  <script async="" src="/assets/scripts/lib/jquery/jquery.retinade.js?  
41172203193"></script>  
  <script async="" src="/assets/scripts/global.js?41172203193"></script>  
  <script async="" src="/assets/scripts/global-logout.js?41172203193"></script>  
  
  <link rel="stylesheet" href="https://www.apple.com/wss/fonts?  
family=SF+Pro&v=2" type="text/css">  
  <link rel="stylesheet" href="https://www.apple.com/wss/fonts?  
family=SF+Pro+Icons&v=1" type="text/css">
```

```
<link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=SF+Mono&v=2" type="text/css">
<link rel="stylesheet" href="https://www.apple.com/wss/fonts?
family=Apple+Icons&v=1" type="text/css">
```

```
<title>Platforms - Platforms - Human Interface Guidelines - Design - Apple
Developer</title>
```

```
<meta name="omni_page" content="Platforms - Platforms - Human
Interface Guidelines - Design - (English)">
```

```
<meta name="Description" content="Platforms">
```

```
<meta name="php check" content="4">
```

```
<meta name="search_thumbnail" content="/design/human-
interface-guidelines/images/thumbnails/platforms/platforms-thumbnail_2x.png">
```

```
<link rel="alternate"
href="https://developer.apple.com/design/human-interface-guidelines/
platforms/overview/" hreflang="en">
```

```
<link rel="canonical"
href="https://developer.apple.com/design/human-interface-guidelines/
platforms/overview/">
```

```
<script
src="/design/human-interface-guidelines/scripts/application.js?
58172205193"></script>
```

```
<script src="/assets/scripts/lib/jquery/jquery.bxslider.min.js?
41172203193"></script>
```

```
<script src="/design/human-interface-guidelines/scripts/hig-nav.js?
58172205193"></script>
```

```
<script
src="/design/human-interface-guidelines/scripts/darkModelImages.js?
59202215202"></script>
```

```
<link rel="stylesheet" type="text/css"
href="/design/human-interface-guidelines/styles/application.css?
14172206193">
```

```
<link rel="stylesheet" type="text/css" href="/design/human-interface-
guidelines/styles/human-interface-guidelines.css?01002216211">
```

```
<style type="text/css">.helpers-
module_transition {
  transition-duration: 160ms;
  transition-timing-function: cubic-bezier(0.25, 0.46, 0.45, 0.94);
}</style><style type="text/css">.SidenavLine_line {
  position: absolute;
  top: 0;
  left: -1px;
  width: 1px;
  height: 25px;
  background: black;
  will-change: transform;
```

```

        transition-property: transform;
    }
</style><style type="text/css">.SidenavItem_children {
    margin: 0;
    opacity: 0.6;
}
.SidenavItem_link {
    opacity: 0.6;
    padding: 0.2em 0;
    border-radius: 4px;
    color: #111;
    font-size: 14px;
    font-weight: 600;
    will-change: opacity;
    transition-property: opacity;
}
.SidenavItem_children .SidenavItem_link {
    font-weight: normal;
}
.SidenavItem_active,
.SidenavItem_link:hover {
    opacity: 1;
    text-decoration: none;
}
</style><style type="text/css">
.Sidenav_container {
    position: sticky;
    position: -webkit-sticky;
    top: 52px;
    left: 100px;
    border-left: 1px solid #e3e3e3;
    padding: 0 18px;
    margin: 0 0 1em;
}
.Sidenav_container * {
    display: block;
}
</style></head>
<body data-hignav-item-name="" data-hignav-is-beta="false" id="platforms-
overview" class="dmf " data-color-scheme="light">

    <link rel="stylesheet" href="/assets/styles/globalnav.css?41172203193"
type="text/css">

    <link rel="stylesheet" href="/assets/styles/suggest-lang.css?41172203193"
type="text/css">
    <div id="suggest-lang" class="ribbon hide">
        <div class="ribbon-content-wrapper">
            <div class="ribbon-content row">
                <div class="column large-12 large-centered">
                    <a id="suggest-closer" class="icon icon-after icon-
reset"></a>
                    <p><a href="#" id="suggest-link" class="ribbon-link
more">View in English</a></p>

```

```

        </div>
    </div>
</div>
<script src="/assets/scripts/suggest-lang.js?41172203193"></script>
<aside id="ac-gn-segmentbar" class="ac-gn-segmentbar" lang="en-US"
dir="ltr">
</aside>
<input type="checkbox" id="ac-gn-menustate" class="ac-gn-menustate">
<nav id="ac-globalnav" class="js touch no-windows" role="navigation" aria-
label="Global" data-hires="false" data-analytics-region="global nav" lang="en-
US" dir="ltr" data-www-domain="www.apple.com" data-store-locale="us" data-
store-root-path="/us" data-store-api="/[storefront]/shop/bag/status" data-
search-locale="en_US"
data-search-suggestions-api="/search-services/suggestions/" data-search-
defaultlinks-api="/search-services/suggestions/defaultlinks/" data-search-
suggestions-enabled="false">
    <div class="ac-gn-content">
        <ul class="ac-gn-header">
            <li class="ac-gn-item ac-gn-menuicon">
                <label class="ac-gn-menuicon-label" for="ac-gn-
menustate" aria-hidden="true">
                    <span class="ac-gn-menuicon-bread ac-gn-
menuicon-bread-top">
                        <span class="ac-gn-menuicon-bread-
crust ac-gn-menuicon-bread-crust-top"></span>
                    </span>
                    <span class="ac-gn-menuicon-bread ac-gn-
menuicon-bread-bottom">
                        <span class="ac-gn-menuicon-bread-
crust ac-gn-menuicon-bread-crust-bottom"></span>
                    </span>
                </label>
                <a href="#ac-gn-menustate" role="button" class="ac-
gn-menuanchor ac-gn-menuanchor-open" id="ac-gn-menuanchor-open">
                    <span class="ac-gn-menuanchor-label">Global
Nav Open Menu</span>
                </a>
                <a href="#" role="button" class="ac-gn-menuanchor
ac-gn-menuanchor-close" id="ac-gn-menuanchor-close">
                    <span class="ac-gn-menuanchor-label">Global
Nav Close Menu</span>
                </a>
            </li>
            <li class="ac-gn-item ac-gn-apple">
                <a class="ac-gn-link ac-gn-link-apple-developer"
href="/" data-analytics-title="appledeveloper home" id="ac-gn-firstfocus-
small">
                    <span class="ac-gn-link-text">Apple
Developer</span>
                </a>
            </li>
        </ul>
        <div class="ac-gn-search-placeholder-container" role="search">

```



```

        <div class="ac-gn-search ac-gn-search-small">
            <a id="ac-gn-link-search-small" class="ac-gn-link"
href="/search/" data-analytics-title="search" data-analytics-click="search" data-
analytics-intrapage-link="" aria-label="Search" role="button" aria-
haspopup="true">
                <div class="ac-gn-search-placeholder-bar">
                    <div class="ac-gn-search-placeholder-
input">
                        <div class="ac-gn-search-
placeholder-input-text" aria-hidden="true">
                            <div class="ac-gn-link-
search ac-gn-search-placeholder-input-icon"></div>
                            <span class="ac-gn-search-
placeholder">Search</span>
                        </div>
                    </div>
                    <div class="ac-gn-searchview-close ac-
gn-searchview-close-small ac-gn-search-placeholder-searchview-close">
                        <span class="ac-gn-searchview-
close-cancel" aria-hidden="true">Cancel</span>
                    </div>
                </div>
            </a>
        </div>
    </div>
    <ul class="ac-gn-list">
        <li class="ac-gn-item ac-gn-apple">
            <a class="ac-gn-link ac-gn-link-apple-developer"
href="/" data-analytics-title="appledveloper home" id="ac-gn-firstfocus">
                <span class="ac-gn-link-text">Apple
Developer</span>
            </a>
        </li>
        <li class="ac-gn-item ac-gn-item-menu ac-gn-news">
            <a class="ac-gn-link ac-gn-link-news" href="/news/"
data-analytics-title="news">
                <span class="ac-gn-link-text">News</span>
            </a>
        </li>
        <li class="ac-gn-item ac-gn-item-menu ac-gn-discover">
            <a class="ac-gn-link ac-gn-link-discover"
href="/discover/" data-analytics-title="discover">
                <span
class="ac-gn-link-text">Discover</span>
            </a>
        </li>
        <li class="ac-gn-item ac-gn-item-menu ac-gn-design">
            <a class="ac-gn-link ac-gn-link-design" href="/design/"
data-analytics-title="design">
                <span class="ac-gn-link-text">Design</span>
            </a>
        </li>
        <li class="ac-gn-item ac-gn-item-menu ac-gn-develop">

```

```

                <a class="ac-gn-link ac-gn-link-develop"
href="/develop/" data-analytics-title="develop">
                    <span class="ac-gn-link-text">Develop</span>
                </a>
            </li>
            <li class="ac-gn-item ac-gn-item-menu ac-gn-distribute">
                <a class="ac-gn-link ac-gn-link-distribute"
href="/distribute/" data-analytics-title="distribute">
                    <span
class="ac-gn-link-text">Distribute</span>
                </a>
            </li>
            <li class="ac-gn-item ac-gn-item-menu ac-gn-dsupport">
                <a class="ac-gn-link ac-gn-link-dsupport"
href="/support/" data-analytics-title="dsupport">
                    <span class="ac-gn-link-text">Support</span>
                </a>
            </li>
            <li class="ac-gn-item ac-gn-item-menu ac-gn-account">
                <a class="ac-gn-link ac-gn-link-account"
href="/account/" data-analytics-title="account">
                    <span class="ac-gn-link-text">Account</span>
                </a>
            </li>
            <li class="ac-gn-item ac-gn-item-menu ac-gn-search"
role="search">
                <a id="ac-gn-link-search" class="ac-gn-link ac-gn-link-
search" href="/search/" data-analytics-title="search" data-analytics-
click="search" data-analytics-intrapage-link="" aria-label="Search"
role="button" aria-haspopup="true"></a>
            </li>
        </ul>
        <aside id="ac-gn-searchview" class="ac-gn-searchview"
role="search" data-analytics-region="search">
            <div class="ac-gn-searchview-content">
                <div class="ac-gn-searchview-bar">
                    <div class="ac-gn-searchview-bar-wrapper">
                        <form id="ac-gn-searchform" class="ac-
gn-searchform" action="/search/" method="get">
                            <div class="ac-gn-searchform-
wrapper">
                                <input id="ac-gn-
searchform-input" class="ac-gn-searchform-input" type="text" name="q" aria-
label="Search" placeholder="Search" autocorrect="off" autocapitalize="off"
autocomplete="off" spellcheck="false" role="combobox" aria-
autocomplete="list" aria-expanded="true" aria-owns="quicklinks suggestions">
                                    <button id="ac-gn-
searchform-submit" class="ac-gn-searchform-submit" type="submit"
disabled="" aria-label="Submit Search"></button>
                                    <button id="ac-gn-
searchform-reset" class="ac-gn-searchform-reset" type="reset" disabled=""
aria-label="Clear Search">
                                        <span
class="ac-gn-searchform-reset-background"></span>

```

```

        </button>
    </div>
    <input type="hidden" id="search-hidden-
input" value="HIG" name="group"></form>
    <button id="ac-gn-searchview-close-
small" class="ac-gn-searchview-close ac-gn-searchview-close-small" aria-
label="Cancel Search">
        <span class="ac-gn-
searchview-close-cancel" aria-hidden="true">
            Cancel
        </span>
    </button>
</div>
</div>
<aside id="ac-gn-searchresults" class="ac-gn-
searchresults" data-string-quicklinks="Quick Links" data-string-
suggestions="Suggested Searches" data-string-noresults="">
    <section class="ac-gn-searchresults-section ac-gn-searchresults-
section-defaultlinks">
        <div class="ac-gn-searchresults-section-wrapper">
            <div class="search-group-
checkbox"><input id="group-input" type="checkbox" name="group-filter"
checked="" value="HIG">Only search within "<span id="group-search-
label">Human Interface Guidelines</span>"</div>
            <h3 class="ac-gn-searchresults-header ac-gn-searchresults-
animated">Quick Links</h3>
            <ul class="ac-gn-searchresults-list" id="defaultlinks"
role="listbox">
                <li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a href="https://developer.apple.com/ios/" id="search-group-link-0"
class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">iOS
16</a></li><li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a href="https://developer.apple.com/news/" id="search-group-link-
1" class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">Latest
News</a></li><li class="ac-gn-searchresults-item ac-gn-searchresults-
animated"><a
href="https://developer.apple.com/documentation/storekit/appstore/
environment/3963900-xcode/" id="search-group-link-2" class="ac-gn-
searchresults-link ac-gn-searchresults-link-defaultlinks">xcode</a></li><li
class="ac-gn-searchresults-item ac-gn-searchresults-animated"><a
href="https://developer.apple.com/xcode/whats-new/" id="search-group-link-3"
class="ac-gn-searchresults-link ac-gn-searchresults-link-defaultlinks">What's
included in Xcode</a></li><li class="ac-gn-searchresults-item ac-gn-
searchresults-animated"><a
href="https://developer.apple.com/videos/play/wwdc2022/110345/" id="search-
group-link-4" class="ac-gn-searchresults-link ac-gn-searchresults-link-
defaultlinks">What's new in Endpoint Security</a></li></ul>
                <span role="status" class="ac-gn-searchresults-count" aria-
live="polite">5 Quick Links</span>
            </div>
        </section>
    </aside>
</div>

```

```

        <button id="ac-gn-searchview-close" class="ac-gn-
searchview-close" aria-label="Cancel Search">
            <span class="ac-gn-searchview-close-
wrapper">
                <span class="ac-gn-searchview-close-
left"></span>
                <span class="ac-gn-searchview-close-
right"></span>
            </span>
        </button>
    </aside>
</div>
</nav>
<div class="ac-gn-blur"></div>
<div id="ac-gn-curtain" class="ac-gn-curtain"></div>
<div id="ac-gn-placeholder" class="ac-nav-placeholder"></div>
<script src="/assets/scripts/ac-globalnav.built.js?41172203193"></script><div
id="ac-gn-viewport-emitter"> </div>
<link rel="stylesheet" href="/assets/styles/search.css?41172203193">
<script src="/assets/scripts/search.js?41172203193"></script>

    <!-- metrics -->
<script>
    /* RSID: */
    var s_account="awdappledeveloper"
</script>
<script src="/assets/metrics/scripts/analytics.js?10202020"></script>
<script>
    s.pageName= AC && AC.Tracking && AC.Tracking.pageName();
    s.channel="www.en.developer"
    s.channel="www.hig.developer";

    /***** DO NOT ALTER ANYTHING BELOW THIS LINE ! *****/
    var s_code=s.t();if(s_code)document.write(s_code)
</script>
<!-- /metrics -->

    <link rel="stylesheet" property="stylesheet"
href="/assets/styles/localnav.css" type="text/css">
<input type="checkbox" id="localnav-menustate" class="localnav-menustate">
<div id="localnav-sticky-placeholder" class="css-sticky
localnav-sticking"></div><nav id="localnav" class="localnav localnav-scrim
css-sticky localnav-sticking" data-sticky="" role="navigation">
    <div class="localnav-wrapper">
        <div class="localnav-background"></div>
        <div class="localnav-content">
            <h2 class="localnav-title">
                <a class="ac-ln-title-logo" href="/design/" data-analytics-
title="product index">Human Interface Guidelines</a>
            </h2>

            <div class="localnav-menu">

```

```

        <a href="#localnav-menustate" class="localnav-menucta-anchor
localnav-menucta-anchor-open" id="localnav-menustate-open">
        <span class="localnav-menucta-anchor-label">Open Menu</span>
    </a>
    <a href="#" class="localnav-menucta-anchor localnav-menucta-
anchor-close" id="localnav-menustate-close">
        <span class="localnav-menucta-anchor-label">Close Menu</span>
    </a>
    <div class="localnav-menu-tray">
<div class="dn-container">
        <nav id="dn-mobile" class="dn localnav-
menu-items" role="navigation" aria-label="Local Navigation" data-hires="true">

```

```

        <ul class="dn-list-container"
style="max-height: 658px; transition: max-height 0.2s ease-in-out 0s;">

```

```

        <li class="dn-list-item dn-icon--active">
                                                                    <span
class="dn-flex">
        <span class="dn-icon dn-icon-platforms dn-list-item--active dn-icon--
active"></span>
        <span class="dn-list-title dn-list-item--active dn-icon--
active">Platforms</span>
                                                                    </span>

```

```

        <ul class="dn-list-container dn--
expanded" style="position: relative; visibility: unset; max-height: 220px;
transition: max-height 0.2s ease-in-out 0s;">

```

```

        <li class="dn-list-item dn-list-item--active">
                                                                    <a
href="/design/human-interface-guidelines/platforms/overview">
                                                                    <span
class="dn-flex">
        <span class="dn-icon dn-icon-overview"
data-hires-status="pending"></span>
        <span>Overview</span>
                                                                    </span>
                                                                    </a>
                                                                    </li>

```

```

        <li class="dn-list-item">

```

```

            Designing for iOS



```

```
- Designing for iPadOS

```

```
- Designing for macOS

```

```
- 

```


Designing for tvOS

<li class="dn-list-item">

<span

class="dn-flex">

Designing for watchOS

<li class="dn-list-item">

<span

class="dn-flex">

Foundations

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

<span

class="dn-flex">

Overview

<li class="dn-list-item">

class="dn-flex">
<span

<span class="dn-icon dn-icon-accessibility" data-hires-
status="pending">

Accessibility

<li class="dn-list-item">

class="dn-flex">
<span

<span class="dn-icon dn-icon-app-icons" data-hires-
status="pending">

App icons

<li class="dn-list-item">

class="dn-flex">
<span

<span class="dn-icon dn-icon-branding"
data-hires-status="pending">

Branding


```
        <li class="dn-list-item">
href="/design/human-interface-guidelines/foundations/color">
class="dn-flex">
        <span class="dn-icon dn-icon-color"
data-hires-status="pending"></span>
        <span>Color</span>
        </li>
</a>
</span>
```

```
        <li class="dn-list-item">
href="/design/human-interface-guidelines/foundations/dark-mode">
class="dn-flex">
        <span class="dn-icon dn-icon-dark-mode" data-hires-
status="pending"></span>
        <span>Dark Mode</span>
        </li>
</a>
</span>
```

```
        <li class="dn-list-item">
href="/design/human-interface-guidelines/foundations/icons">
class="dn-flex">
        <span class="dn-icon dn-icon-icons"
data-hires-status="pending"></span>
        <span>Icons</span>
        </li>
</a>
</span>
```

```
        <li class="dn-list-item">
href="/design/human-interface-guidelines/foundations/images">
```

```
class="dn-flex">
    <span class="dn-icon dn-icon-images"
data-hires-status="pending"></span>
    <span>Images</span>
    </span>
</a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/foundations/inclusion">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-inclusion"
data-hires-status="pending"></span>
        <span>Inclusion</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/foundations/layout">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-layout"
data-hires-status="pending"></span>
        <span>Layout</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/foundations/materials">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-materials" data-hires-
status="pending"></span>
```

Materials

<li class="dn-list-item">

href="/design/human-interface-guidelines/foundations/motion">
class="dn-flex">

<span

<span class="dn-icon dn-icon-motion"
data-hires-status="pending">

Motion

<li class="dn-list-item">

href="/design/human-interface-guidelines/foundations/right-to-left">
class="dn-flex">

<span

<span class="dn-icon dn-icon-right-to-left" data-hires-
status="pending">

Right to left

<li class="dn-list-item">

href="/design/human-interface-guidelines/foundations/sf-symbols">
class="dn-flex">

<span

<span class="dn-icon dn-icon-sf-symbols" data-hires-
status="pending">

SF Symbols


```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/accessing-private-data">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-accessing-private-data" data-hires-
status="pending"></span>
                    <span>Accessing private data</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/drag-and-drop">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-drag-and-drop" data-hires-
status="pending"></span>
                    <span>Drag and drop</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/entering-data">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-entering-data" data-hires-
status="pending"></span>
                    <span>Entering data</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/feedback">
                <span
class="dn-flex">

```

<span class="dn-icon dn-icon-feedback"
data-hires-status="pending">

Feedback

<li class="dn-list-item">

class="dn-flex">

<span

<span class="dn-icon dn-icon-file-management" data-hires-
status="pending">

File management

<li class="dn-list-item">

class="dn-flex">

<span

<span class="dn-icon dn-icon-going-full-screen" data-hires-
status="pending">

Going full screen

<li class="dn-list-item">

class="dn-flex">

<span

<span class="dn-icon dn-icon-launching" data-hires-
status="pending">

Launching


```
</a>
</li>
```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/patterns/live-viewing-apps">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-live-viewing-apps" data-hires-
status="pending"></span>
      <span>Live-viewing apps</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/patterns/loading">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-loading"
data-hires-status="pending"></span>
      <span>Loading</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/patterns/managing-accounts">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-managing-accounts" data-hires-
status="pending"></span>
      <span>Managing accounts</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
```


Offering help

<li class="dn-list-item">

class="dn-flex">

<span

Onboarding

<li class="dn-list-item">

class="dn-flex">

<span

Playing audio

<li class="dn-list-item">

class="dn-flex">

<span

Playing haptics


```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/patterns/playing-video">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-playing-video" data-hires-
status="pending"></span>
      <span>Playing video</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/patterns/printing">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-printing"
data-hires-status="pending"></span>
      <span>Printing</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/patterns/ratings-and-reviews">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-ratings-and-reviews" data-hires-
status="pending"></span>
      <span>Ratings and reviews</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
```

```
href="/design/human-interface-guidelines/patterns/searching">
class="dn-flex">
    <span class="dn-icon dn-icon-searching" data-hires-
status="pending"></span>
    <span>Searching</span>
</li>
</a>
</span>
```

```
<li class="dn-list-item">
href="/design/human-interface-guidelines/patterns/settings">
class="dn-flex">
    <span class="dn-icon dn-icon-settings"
data-hires-status="pending"></span>
    <span>Settings</span>
</li>
</a>
</span>
```

```
<li class="dn-list-item">
href="/design/human-interface-guidelines/patterns/undo-and-redo">
class="dn-flex">
    <span class="dn-icon dn-icon-undo-and-redo" data-hires-
status="pending"></span>
    <span>Undo and redo</span>
</li>
</a>
</span>
```

```
<li class="dn-list-item">
href="/design/human-interface-guidelines/patterns/workouts">
class="dn-flex">
```

<span class="dn-icon dn-icon-workouts"
data-hires-status="pending">

Workouts

<li class="dn-list-item">

class="dn-flex">

<span

Components

<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item dn-list-item-link">

<span class="dn-icon dn-icon-all-components" data-hires-
status="pending">

All components

<li class="dn-list-item">

class="dn-flex">

<span

```
<span class="dn-icon dn-icon-content" data-hires-status="pending"></span>
```

```
<span class="dn-list-title">Content</span>
```

```
</span>
```

```
<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item">
```

```
<a href="/design/human-interface-guidelines/components/content/image-views">  
<span class="dn-flex">
```

```
<span class="dn-icon dn-icon-image-views"></span>
```

```
<span>Image views</span>
```

```
</span>
```

```
</a>
```

```
</li>
```

```
<li class="dn-list-item">
```

```
<a href="/design/human-interface-guidelines/components/content/text-views">  
<span class="dn-flex">
```

```
<span class="dn-icon dn-icon-text-views"></span>
```

```
<span>Text views</span>
```

```
</span>
```

```
</a>
```

```
</li>
```

```
<li class="dn-list-item">
```

```
<a href="/design/human-interface-guidelines/components/content/web-views">  
<span class="dn-flex">
```

```
<span class="dn-icon dn-icon-web-views"></span>
```

```
<span>Web views</span>
```

```
</span>
```

```
</a>
```

```
</li>
```



```
<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-layout-and-organization" data-hires-
status="pending"></span>
    <span class="dn-list-title">Layout and organization</span>
    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/components/layout-and-organization/
boxes">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-boxes"></span>
          <span>Boxes</span>
        </span>
      </a>
    </li>
```

```
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/components/layout-and-organization/
collections">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-collections"></span>
          <span>Collections</span>
        </span>
      </a>
    </li>
```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/layout-and-organization/
column-views">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-column-views"></span>
                    <span>Column views</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/layout-and-organization/
disclosure-controls">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-disclosure-controls"></span>
                    <span>Disclosure controls</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/layout-and-organization/
labels">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-labels"></span>
                    <span>Labels</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/layout-and-organization/
lists-and-tables">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-lists-and-tables"></span>
    <span>Lists and tables</span>
    </span>
</a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/layout-and-organization/
lockups">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-lockups"></span>
            <span>Lockups</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/layout-and-organization/
outline-views">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-outline-views"></span>
            <span>Outline views</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/layout-and-organization/
split-views">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-split-views"></span>
            <span>Split views</span>
```



```

</span>
</a>
</li>

<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/components/layout-and-organization/
tab-views">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-tab-views"></span>
      <span>Tab views</span>
    </a>
  </li>
</ul>
</li>
```

```

<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-menus-and-actions" data-hires-
status="pending"></span>
    <span class="dn-list-title">Menus and actions</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/components/menus-and-actions/
activity-views">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-activity-views"></span>
          <span>Activity views</span>
        </span>
      </a>
    </li>
  </ul>
</li>
```

```
</a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/components/menus-and-actions/  
buttons">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-buttons"></span>  
      <span>Buttons</span>  
    </span>  
  </a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/components/menus-and-actions/  
context-menus">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-context-menus"></span>  
      <span>Context menus</span>  
    </span>  
  </a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/components/menus-and-actions/dock-  
menus">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-dock-menus"></span>  
      <span>Dock menus</span>  
    </span>  
  </a>  
</li>
```

```
<li class="dn-list-item">
```



```
<span class="dn-icon dn-icon-pull-down-buttons"></span>
<span>Pull-down buttons</span>
</li>
</a>
</span>
</li>
<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/components/menus-and-actions/
toolbars">
<span
class="dn-flex">
<span class="dn-icon dn-icon-toolbars"></span>
<span>Toolbars</span>
</span>
</a>
</li>
</ul>
</li>
```

```
<li class="dn-list-item">
<span
class="dn-flex">
<span class="dn-icon dn-icon-navigation-and-search" data-hires-
status="pending"></span>
<span class="dn-list-title">Navigation and search</span>
</span>
<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/components/navigation-and-search/
navigation-bars">
<span
class="dn-flex">
```


Navigation bars

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/navigation-and-search/
path-controls">

<span

class="dn-flex">

Path controls

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/navigation-and-search/
search-fields">

<span

class="dn-flex">

Search fields

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/navigation-and-search/
sidebars">

<span

class="dn-flex">

Sidebars

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/navigation-and-search/
tab-bars">

<span

class="dn-flex">

Tab bars

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/navigation-and-search/
token-fields">

<span

class="dn-flex">

Token fields

<li class="dn-list-item">

<span

class="dn-flex">

<span class="dn-icon dn-icon-presentation" data-hires-
status="pending">

Presentation


```

                                <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

                                <li class="dn-list-item">

                                <a
href="/design/human-interface-guidelines/components/presentation/action-
sheets">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-action-sheets"></span>
                                <span>Action sheets</span>
                                </span>
                                </a>
                                </li>

```

```

                                <li class="dn-list-item">

                                <a
href="/design/human-interface-guidelines/components/presentation/alerts">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-alerts"></span>
                                <span>Alerts</span>
                                </span>
                                </a>
                                </li>

```

```

                                <li class="dn-list-item">

                                <a
href="/design/human-interface-guidelines/components/presentation/page-
controls">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-page-controls"></span>
                                <span>Page controls</span>
                                </span>
                                </a>
                                </li>

```

```

                                <li class="dn-list-item">

                                <a
href="/design/human-interface-guidelines/components/presentation/panels">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-panels"></span>
    <span>Panels</span>
    </span>
</a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/presentation/popovers">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-popovers"></span>
        <span>Popovers</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/presentation/scroll-
views">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-scroll-views"></span>
        <span>Scroll views</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/presentation/sheets">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-sheets"></span>
        <span>Sheets</span>
    </span>
    </a>
```



```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/components/presentation/windows">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-windows"></span>
      <span>Windows</span>
    </span>
  </a>
</li>
```



```
<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-selection-and-input" data-hires-
status="pending"></span>
    <span class="dn-list-title">Selection and input</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/components/selection-and-input/color-
wells">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-color-wells"></span>
          <span>Color wells</span>
        </span>
      </a>
    </li>
```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/selection-and-input/
combo-boxes">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-combo-boxes"></span>
                    <span>Combo boxes</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/selection-and-input/digit-
entry-views">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-digit-entry-views"></span>
                    <span>Digit entry views</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/selection-and-input/
image-wells">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-image-wells"></span>
                    <span>Image wells</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/selection-and-input/
onscreen-keyboards">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-onscreen-keyboards"></span>
    <span>Onscreen keyboards</span>
    </span>
</a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/selection-and-input/
pickers">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-pickers"></span>
            <span>Pickers</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/selection-and-input/
segmented-controls">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-segmented-controls"></span>
            <span>Segmented controls</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/selection-and-input/
sliders">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-sliders"></span>
            <span>Sliders</span>
```

```

</span>
</a>
</li>

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/components/selection-and-input/
steppers">
<span
class="dn-flex">
<span class="dn-icon dn-icon-steppers"></span>
<span>Steppers</span>
</span>
</a>
</li>

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/components/selection-and-input/text-
fields">
<span
class="dn-flex">
<span class="dn-icon dn-icon-text-fields"></span>
<span>Text fields</span>
</span>
</a>
</li>

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/components/selection-and-input/
toggles">
<span
class="dn-flex">
<span class="dn-icon dn-icon-toggles"></span>
<span>Toggles</span>
</span>
</a>
</li>

</ul>
```



```
<li class="dn-list-item">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-status"
data-hires-status="pending"></span>
        <span class="dn-list-title">Status</span>
    </span>
    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/status/activity-rings">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-activity-rings"></span>
                    <span>Activity rings</span>
                </span>
            </a>
        </li>
```

```
        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/status/level-indicators">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-level-indicators"></span>
                    <span>Level indicators</span>
                </span>
            </a>
        </li>
```

```
<li class="dn-list-item">
```

```

                                <a
href="/design/human-interface-guidelines/components/status/progress-
indicators">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-progress-indicators"></span>
    <span>Progress indicators</span>
                                </span>
                                </a>
                                </li>
                                </ul>
                                </li>

```

```

    <li class="dn-list-item">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-system-experiences" data-hires-
status="pending"></span>
    <span class="dn-list-title">System experiences</span>
                                </span>
                                <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/components/system-experiences/
complications">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-complications"></span>
    <span>Complications</span>
                                </span>
                                </a>
                                </li>
    <li class="dn-list-item">

```


Status bars

<li class="dn-list-item">

<span

class="dn-flex">

Top Shelf

<li class="dn-list-item">

<span

class="dn-flex">

Watch faces

<li class="dn-list-item">

<span

class="dn-flex">

Widgets


```

</li>

</ul>

</li>

</ul>

</li>

<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-inputs"></span>
    <span class="dn-list-title">Inputs</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/inputs/overview">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-overview"
data-hires-status="pending"></span>
          <span>Overview</span>
        </span>
      </a>
    </li>

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/inputs/apple-pencil-and-scribble">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-apple-pencil-and-scribble" data-hires-
status="pending"></span>

```

Apple Pencil and Scribble

<li class="dn-list-item">

href="/design/human-interface-guidelines/inputs/digital-crown">
class="dn-flex">

<span

Digital Crown

<li class="dn-list-item">

href="/design/human-interface-guidelines/inputs/focus-and-selection">
class="dn-flex">

<span

Focus and selection

<li class="dn-list-item">

href="/design/human-interface-guidelines/inputs/game-controllers">
class="dn-flex">

<span

Game controllers


```

    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/inputs/gyro-and-accelerometer">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-gyro-and-accelerometer" data-hires-
status="pending"></span>
                <span>Gyro and accelerometer</span>
            </span>
        </a>
    </li>

```

```

    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/inputs/keyboards">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-keyboards" data-hires-
status="pending"></span>
                <span>Keyboards</span>
            </span>
        </a>
    </li>

```

```

    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/inputs/pointing-devices">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-pointing-devices" data-hires-
status="pending"></span>
                <span>Pointing devices</span>
            </span>
        </a>
    </li>

```

```

    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/inputs/remotes">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-remotes"
data-hires-status="pending"></span>
    <span>Remotes</span>
</li>
</a>
</span>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/inputs/spatial-interactions">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-spatial-interactions" data-hires-
status="pending"></span>
        <span>Spatial interactions</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/inputs/touch-bar">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-touch-bar" data-hires-
status="pending"></span>
        <span>Touch Bar</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/inputs/touchscreen-gestures">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-touchscreen-gestures" data-hires-
status="pending"></span>
```

```
<span>Touchscreen gestures</span>
</a>
</li>
</ul>
</li>
```

```
<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-technologies"></span>
    <span class="dn-list-title">Technologies</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item dn-list-item-link">
  <a
href="/design/human-interface-guidelines/technologies/all-technologies">
    <span class="dn-flex">
      <span class="dn-icon dn-icon-all-technologies" data-hires-
status="pending"></span>
      <span>All technologies</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <span
class="dn-flex">
```

<span class="dn-icon dn-icon-airplay"
data-hires-status="pending">

AirPlay

<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

class="dn-flex">

<span

Introduction

<li class="dn-list-item">

class="dn-flex">

<span

<span class="dn-icon dn-icon-icons"
data-hires-status="pending">

Icons

<li class="dn-list-item">

class="dn-flex">

<span

Editorial

<li class="dn-list-item dn-list-item-link">

Always On

<li class="dn-list-item">

App Clips

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

Introduction

<li class="dn-list-item">

class="dn-flex">
<span

User experience

<li class="dn-list-item">

class="dn-flex">
<span

App Clip card

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/app-clips/app-clip-
codes">

<span

class="dn-flex">

App Clip Codes

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/app-clips/printing-
guidelines">

<a


```

class="dn-flex">
    <span class="dn-icon dn-icon-printing-guidelines"></span>
    <span>Printing guidelines</span>
    </span>
    </a>
</li>

    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/technologies/app-clips/legal-
requirements">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-legal-requirements"></span>
                <span>Legal requirements</span>
            </span>
            </a>
        </li>

    </ul>

</li>

    <li class="dn-list-item">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-apple-pay" data-hires-
status="pending"></span>
            <span class="dn-list-title">Apple Pay</span>
        </span>
        <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
            <li class="dn-list-item">
                <a
href="/design/human-interface-guidelines/technologies/apple-pay/introduction">
                    <span
class="dn-flex">
```


Introduction

<li class="dn-list-item">

<span

class="dn-flex">

Offering Apple Pay

<li class="dn-list-item">

<span

class="dn-flex">

Checkout and payment

<li class="dn-list-item">

<span

class="dn-flex">

Error handling

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/apple-pay/subscriptions-
and-donations">

<span
class="dn-flex">

Subscriptions and donations

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/apple-pay/buttons-and-
marks">

<span
class="dn-flex">

Buttons and marks

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/apple-pay/editorial-
guidelines">

<span
class="dn-flex">

Editorial


```
<li class="dn-list-item dn-list-item-link">
    <a
href="/design/human-interface-guidelines/technologies/augmented-reality">
    <span class="dn-flex">
    <span class="dn-icon dn-icon-augmented-reality" data-hires-
status="pending"></span>
    <span>Augmented reality</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <span
class="dn-flex">
    <span class="dn-icon dn-icon-carekit"
data-hires-status="pending"></span>
    <span class="dn-list-title">CareKit</span>
    </span>
    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/technologies/carekit/introduction">
        <span
class="dn-flex">
        <span class="dn-icon dn-icon-introduction"></span>
        <span>Introduction</span>
        </span>
        </a>
    </li>
```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/carekit/data-and-
privacy">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-data-and-privacy"></span>
                    <span>Data and privacy</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/carekit/views">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-views"></span>
                    <span>Views</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/carekit/user-
experience">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-user-experience"></span>
                    <span>User experience</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/carekit/symbols-and-
branding">
                <span
class="dn-flex">

```

```
<span class="dn-icon dn-icon-symbols-and-branding"></span>
<span>Symbols and branding</span>
</li>
</ul>
</li>
```

```
<li class="dn-list-item">
  <span class="dn-flex">
    <span class="dn-icon dn-icon-carplay"
      data-hires-status="pending"></span>
    <span class="dn-list-title">CarPlay</span>
  </span>
  <ul class="dn-list-container"
    style="transition: max-height 0.2s ease-in-out 0s;">
```

```
    <li class="dn-list-item">
      <a href="/design/human-interface-guidelines/technologies/carplay/introduction">
        <span class="dn-flex">
          <span class="dn-icon dn-icon-introduction"></span>
          <span>Introduction</span>
        </span>
      </a>
    </li>
```

```
    <li class="dn-list-item">
      <a href="/design/human-interface-guidelines/technologies/carplay/architecture">
        <span class="dn-flex">
          <span class="dn-icon dn-icon-architecture"></span>
```

Architecture

<li class="dn-list-item">

href="/design/human-interface-guidelines/technologies/carplay/interaction">
class="dn-flex">
<span

Interaction

<li class="dn-list-item">

href="/design/human-interface-guidelines/technologies/carplay/visual-design">
class="dn-flex">
<span

Visual design

<li class="dn-list-item">

href="/design/human-interface-guidelines/technologies/carplay/icons-and-images">
class="dn-flex">
<span

Icons and images


```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/carplay/system-
elements">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-system-elements"></span>
                    <span>System elements</span>
                </a>
            </li>
        </ul>
    </li>

```

```

        <li class="dn-list-item">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-game-center" data-hires-
status="pending"></span>
                <span class="dn-list-title">Game Center</span>
            </span>
            <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/game-center/
introduction">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-introduction"></span>
                    <span>Introduction</span>
                </a>
            </li>

```



```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/game-center/access-
point">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-access-point"></span>
                    <span>Access point</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/game-center/
dashboard">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-dashboard"></span>
                    <span>Dashboard</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/game-center/
achievements">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-achievements"></span>
                    <span>Achievements</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/game-center/
leaderboards">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-leaderboards"></span>
    <span>Leaderboards</span>
    </span>
</a>
</li>
```

```

    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/technologies/game-center/
multiplayer">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-multiplayer"></span>
                <span>Multiplayer</span>
            </span>
        </a>
    </li>
```

```

    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/technologies/game-center/custom-
dashboard-links">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-custom-dashboard-links"></span>
                <span>Custom dashboard links</span>
            </span>
        </a>
    </li>
```

```
</ul>
```

```
</li>
```

```
<li class="dn-list-item dn-list-item-link">
```

```

href="/design/human-interface-guidelines/technologies/healthkit">
    <a
    <span class="dn-flex">
        <span class="dn-icon dn-icon-healthkit"
data-hires-status="pending"></span>
        <span>HealthKit</span>
    </span>
    </a>
</li>

    <li class="dn-list-item">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-homekit"
data-hires-status="pending"></span>
            <span class="dn-list-title">HomeKit</span>
        </span>
        <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
            <li class="dn-list-item">
                <a
href="/design/human-interface-guidelines/technologies/homekit/introduction">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-introduction"></span>
                    <span>Introduction</span>
                </span>
            </li>
            <li class="dn-list-item">
                <a
href="/design/human-interface-guidelines/technologies/homekit/terminology-
and-layout">
                <span
class="dn-flex">

```


Terminology and layout

<li class="dn-list-item">

<span

class="dn-flex">

Setup

<li class="dn-list-item">

<span

class="dn-flex">

Siri interactions

<li class="dn-list-item">

<span

class="dn-flex">

Custom functionality


```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/homekit/icons">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-icons"
data-hires-status="pending"></span>
                <span>Icons</span>
            </span>
        </a>
    </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/homekit/editorial">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-editorial"></span>
                <span>Editorial</span>
            </span>
        </a>
    </li>

```

```

    </ul>

```

```

    </li>

```

```

    <li class="dn-list-item dn-list-item-link">
        <a
href="/design/human-interface-guidelines/technologies/icloud">
            <span class="dn-flex">
                <span class="dn-icon dn-icon-icloud"
data-hires-status="pending"></span>
                <span>iCloud</span>
            </span>
        </a>
    </li>

```

```
</a>
</li>
```

```
<li class="dn-list-item">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-in-app-purchase" data-hires-
status="pending"></span>
        <span class="dn-list-title">In-app purchase</span>
    </span>
    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/in-app-purchase/
introduction">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-introduction"></span>
            <span>Introduction</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/in-app-purchase/auto-
renewable-subscriptions">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-auto-renewable-subscriptions"></span>
            <span>Auto-renewable subscriptions</span>
        </span>
    </a>
</li>
```

```
</ul>
```



```
<li class="dn-list-item dn-list-item-link">
  <a
href="/design/human-interface-guidelines/technologies/live-photos">
  <span class="dn-flex">
    <span class="dn-icon dn-icon-live-photos" data-hires-
status="pending"></span>
    <span>Live Photos</span>
  </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-mac-catalyst" data-hires-
status="pending"></span>
    <span class="dn-list-title">Mac Catalyst</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/
introduction">
      <span
class="dn-flex">
        <span class="dn-icon dn-icon-introduction"></span>
        <span>Introduction</span>
      </span>
    </a>
  </li>
```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/app-
structure">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-app-structure"></span>
                    <span>App structure</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/user-
interaction">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-user-interaction"></span>
                    <span>User interaction</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/visual-
design">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-visual-design"></span>
                    <span>Visual design</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/mac-
idiom">

```



```
class="dn-flex">
    <span class="dn-icon dn-icon-mac-idiom"></span>
    <span>Mac idiom</span>
    </span>
    </a>
</li>
</ul>
```

```
<li class="dn-list-item">
    class="dn-flex">
        <span class="dn-icon dn-icon-machine-learning" data-hires-
        status="pending"></span>
        <span class="dn-list-title">Machine learning</span>
        </span>
        <ul class="dn-list-container"
        style="transition: max-height 0.2s ease-in-out 0s;">
```

```
    <li class="dn-list-item">
        <a
        href="/design/human-interface-guidelines/technologies/machine-learning/
        introduction">
            <span
            class="dn-flex">
                <span class="dn-icon dn-icon-introduction"></span>
                <span>Introduction</span>
                </span>
            </a>
        </li>
```

```
    <li class="dn-list-item">
        <a
        href="/design/human-interface-guidelines/technologies/machine-learning/roles">
            <span
            class="dn-flex">
```


Machine learning roles

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/technologies/machine-learning/
explicit-feedback">

<span

class="dn-flex">

Explicit feedback

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/technologies/machine-learning/
implicit-feedback">

<span

class="dn-flex">

Implicit feedback

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/technologies/machine-learning/
calibration">

<span

class="dn-flex">

Calibration


```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/technologies/machine-learning/
corrections">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-corrections"></span>
      <span>Corrections</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/technologies/machine-learning/
mistakes">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-mistakes"></span>
      <span>Mistakes</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/technologies/machine-learning/
multiple-options">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-multiple-options"></span>
      <span>Multiple options</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
```

```

                                <a
href="/design/human-interface-guidelines/technologies/machine-learning/
confidence">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-confidence"></span>
    <span>Confidence</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/machine-learning/
attribution">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-attribution"></span>
    <span>Attribution</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/machine-learning/
limitations">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-limitations"></span>
    <span>Limitations</span>
                                </span>
                                </a>
                                </li>

```

```

    </ul>

```

```

    </li>

```

```

        <li class="dn-list-item">
                                                    <span
class="dn-flex">
        <span class="dn-icon dn-icon-maps"
data-hires-status="pending"></span>
        <span class="dn-list-title">Maps</span>
                                                    </span>

```

```

                                <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```

```

        <li class="dn-list-item">
                                                    <a
href="/design/human-interface-guidelines/technologies/maps/introduction">
                                                    <span
class="dn-flex">
        <span class="dn-icon dn-icon-introduction"></span>
        <span>Introduction</span>
                                                    </span>
                                                    </a>
        </li>

```

```

        <li class="dn-list-item">
                                                    <a
href="/design/human-interface-guidelines/technologies/maps/apple-watch-
maps">
                                                    <span
class="dn-flex">
        <span class="dn-icon dn-icon-apple-watch-maps"></span>
        <span>Apple Watch maps</span>
                                                    </span>
                                                    </a>
        </li>

```

```

        <li class="dn-list-item">
                                                    <a
href="/design/human-interface-guidelines/technologies/maps/indoor-maps">
                                                    <span
class="dn-flex">
        <span class="dn-icon dn-icon-indoor-maps"></span>

```

```

        <span>Indoor maps</span>
                                </span>
                                </a>
        </li>
    </ul>
                                </li>

    <li class="dn-list-item">
        class="dn-flex">
            <span class="dn-icon dn-icon-messages-for-business" data-hires-
            status="pending"></span>
            <span class="dn-list-title">Messages for Business</span>
                                </span>
                                <ul class="dn-list-container"
                                style="transition: max-height 0.2s ease-in-out 0s;">
                                    <li class="dn-list-item">
                                        <a
                                        href="/design/human-interface-guidelines/technologies/messages-for-business/
                                        introduction">
                                            <span
                                            class="dn-flex">
                                                <span class="dn-icon dn-icon-introduction"></span>
                                                <span>Introduction</span>
                                            </span>
                                            </a>
                                    </li>

                                    <li class="dn-list-item">
                                        <a
                                        href="/design/human-interface-guidelines/technologies/messages-for-business/
                                        branding">
                                            <span
                                            class="dn-flex">
                                                <span class="dn-icon dn-icon-branding"
                                                data-hires-status="pending"></span>

```

Branding

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/messages-for-business/
buttons">

<span
class="dn-flex">

Buttons

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/messages-for-business/
color">

<span
class="dn-flex">

<span class="dn-icon dn-icon-color"
data-hires-status="pending">

Color

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/messages-for-business/
dark-mode">

<span
class="dn-flex">

<span class="dn-icon dn-icon-dark-mode" data-hires-
status="pending">

Dark Mode


```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
logo">
      <span
class="dn-flex">
        <span class="dn-icon dn-icon-logo"></span>
        <span>Logo</span>
      </span>
    </a>
  </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
message-bubble-content">
      <span
class="dn-flex">
        <span class="dn-icon dn-icon-message-bubble-content"></span>
        <span>Message bubble content</span>
      </span>
    </a>
  </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
screenshots">
      <span
class="dn-flex">
        <span class="dn-icon dn-icon-screenshots"></span>
        <span>Screenshots</span>
      </span>
    </a>
  </li>

```



```
<li class="dn-list-item dn-list-item-link">

```

```
<li class="dn-list-item dn-list-item-link">

```

```
<li class="dn-list-item dn-list-item-link">

```

ResearchKit

<li class="dn-list-item dn-list-item-link">

href="/design/human-interface-guidelines/technologies/shareplay"> <a>

SharePlay

<li class="dn-list-item dn-list-item-link">

href="/design/human-interface-guidelines/technologies/shazamkit"> <a>

ShazamKit

<li class="dn-list-item">

class="dn-flex">

Sign in with Apple

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

Introduction

<li class="dn-list-item">

Data management

<li class="dn-list-item">

Buttons

<li class="dn-list-item">
class="dn-flex">

Siri

<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">
href="/design/human-interface-guidelines/technologies/siri/introduction">
class="dn-flex">

Introduction

<li class="dn-list-item">
href="/design/human-interface-guidelines/technologies/siri/system-intents">
class="dn-flex">

System intents


```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/siri/custom-intents">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-custom-intents"></span>
                    <span>Custom intents</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/siri/shortcuts-and-
suggestions">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-shortcuts-and-suggestions"></span>
                    <span>Shortcuts and suggestions</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/siri/editorial-guidelines">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-editorial-guidelines"></span>
                    <span>Editorial</span>
                </a>
            </li>

```

```

    </ul>

```

```

</li>

```

```
<li class="dn-list-item dn-list-item-link">
    <a
href="/design/human-interface-guidelines/technologies/tap-to-pay-on-iphone">
    <span class="dn-flex">
        <span class="dn-icon dn-icon-tap-to-pay-on-iphone" data-hires-
status="pending"></span>
        <span>Tap to Pay on iPhone</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-wallet"
data-hires-status="pending"></span>
        <span class="dn-list-title">Wallet</span>
    </span>
```

```
<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/wallet/introduction">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-introduction"></span>
        <span>Introduction</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
```

```

                                <a
href="/design/human-interface-guidelines/technologies/wallet/designing-
passes">
                                <span
class="dn-flex">
        <span class="dn-icon dn-icon-designing-passes"></span>
        <span>Designing passes</span>
                                </span>
                                </a>
                                </li>
                                <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/wallet/designing-order-
tracking">
                                <span
class="dn-flex">
        <span class="dn-icon dn-icon-designing-order-tracking"></span>
        <span>Designing order tracking</span>
                                </span>
                                </a>
                                </li>
                                </ul>
                                </li>
                                </ul>
                                </li>
                                </ul>
                                </div>
                                </nav>
                                <ul class="localnav-menu-items">
                                <li class="localnav-menu-item">
                                <a href="/design/" class="localnav-menu-link">Overview</a>
                                </li>
                                <li class="localnav-menu-item">
                                <a href="/design/whats-new/" class="localnav-menu-
link">What's New</a>
                                </li>

```

```

        <li class="localnav-menu-item">
            <a
href="/design/human-interface-guidelines/guidelines/overview" class="localnav-
menu-link">Guidelines</a>
        </li>
        <li class="localnav-menu-item">
            <a href="/design/awards/" class="localnav-menu-link">Design
Awards</a>
        </li>
        <li class="localnav-menu-item">
            <a href="/videos/design/" class="localnav-menu-
link">Videos</a>
        </li>
        <li class="localnav-menu-item">
            <a href="/design/resources/" class="localnav-menu-
link">Resources</a>
        </li>
    </ul>
</div>
<div class="localnav-actions">
    <div class="localnav-action localnav-action-menucta" aria-
hidden="true">
        <label for="localnav-menustate" class="localnav-menucta">
            <span class="localnav-menucta-chevron"></span>
        </label>
    </div>
</div>

</div>
</div>
</div>
</nav>
<label id="localnav-curtain" for="localnav-menustate"></label>
<script src="/assets/scripts/ac-localnav.built.js"></script><div id="localnav-
viewport-emitter" data-viewport-emitter-dispatch="" data-viewport-emitter-
state="{&quot;viewport&quot;;&quot;small&quot;;&quot;orientation&quot;;&quot;
t;portrait&quot;;&quot;retina&quot;;true}"></div>
<script type="text/javascript" src="/assets/scripts/localnav.js"></script>

    <main id="main" class="main main-hig" role="main">

        <!-- HIG content -->
        <section class="section section-hig-container" id="section-hig-
container">
            <div id="grid-spacer"></div>
            <div class="section-content">
                <div class="row row-hig-container" id="row-hig-
container">

                    <!-- Side navigation -->
                    <div class="column dn-container small-hide"
style="align-self: flex-start;">
                        <nav id="dn" class="dn"
role="navigation" aria-label="Local Navigation" data-hires="true">

```



```

<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

  <li class="dn-list-item dn-icon--active">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-platforms dn-list-item--active dn-icon--
active"></span>
      <span class="dn-list-title dn-list-item--active dn-icon--
active">Platforms</span>
    </span>

```

```

<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

  <li class="dn-list-item dn-list-item--active">
    <a
href="/design/human-interface-guidelines/platforms/overview">
      <span
class="dn-flex">
        <span class="dn-icon dn-icon-overview"
data-hires-status="pending"></span>
        <span>Overview</span>
      </span>
    </a>
  </li>

```

```

<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/platforms/designing-for-ios">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-designing-for-ios" data-hires-
status="pending"></span>
      <span>Designing for iOS</span>
    </span>
  </a>
</li>

```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/platforms/designing-for-ipados">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-designing-for-ipados" data-hires-
status="pending"></span>
        <span>Designing for iPadOS</span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/platforms/designing-for-macos">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-designing-for-macos" data-hires-
status="pending"></span>
        <span>Designing for macOS</span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/platforms/designing-for-tvos">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-designing-for-tvos" data-hires-
status="pending"></span>
        <span>Designing for tvOS</span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/platforms/designing-for-watchos">
    <span
class="dn-flex">
```


Designing for watchOS

<li class="dn-list-item">

class="dn-flex">

<span

Foundations

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

<span

class="dn-flex">

Overview

<li class="dn-list-item">

<span

class="dn-flex">

Accessibility

<li class="dn-list-item">

<span

class="dn-flex">

App icons

<li class="dn-list-item">

<span

class="dn-flex">

Branding

<li class="dn-list-item">

<span

class="dn-flex">

Color

<li class="dn-list-item">

class="dn-flex">

<span

<span class="dn-icon dn-icon-dark-mode" data-hires-
status="pending">

Dark Mode

<li class="dn-list-item">

class="dn-flex">

<span

<span class="dn-icon dn-icon-icons"
data-hires-status="pending">

Icons

<li class="dn-list-item">

class="dn-flex">

<span

<span class="dn-icon dn-icon-images"
data-hires-status="pending">

Images

<li class="dn-list-item">

Motion

<li class="dn-list-item">

class="dn-flex">

<span

Right to left

<li class="dn-list-item">

class="dn-flex">

<span

SF Symbols

<li class="dn-list-item">

class="dn-flex">

<span

Typography


```
<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-patterns"></span>
    <span class="dn-list-title">Patterns</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/patterns/overview">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-overview"
data-hires-status="pending"></span>
          <span>Overview</span>
        </span>
      </a>
    </li>
```

```
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/patterns/accessing-private-data">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-accessing-private-data" data-hires-
status="pending"></span>
          <span>Accessing private data</span>
        </span>
      </a>
    </li>
```



```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/patterns/drag-and-drop">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-drag-and-drop" data-hires-
status="pending"></span>
          <span>Drag and drop</span>
        </span>
      </a>
    </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/patterns/entering-data">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-entering-data" data-hires-
status="pending"></span>
          <span>Entering data</span>
        </span>
      </a>
    </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/patterns/feedback">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-feedback"
data-hires-status="pending"></span>
          <span>Feedback</span>
        </span>
      </a>
    </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/patterns/file-management">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-file-management" data-hires-
status="pending"></span>
    <span>File management</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/going-full-screen">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-going-full-screen" data-hires-
status="pending"></span>
        <span>Going full screen</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/launching">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-launching" data-hires-
status="pending"></span>
        <span>Launching</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/live-viewing-apps">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-live-viewing-apps" data-hires-
status="pending"></span>
```

Live-viewing apps

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/loading">
class="dn-flex">

<a
<span

<span class="dn-icon dn-icon-loading"
data-hires-status="pending">

Loading

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/managing-accounts">
class="dn-flex">

<a
<span

<span class="dn-icon dn-icon-managing-accounts" data-hires-
status="pending">

Managing accounts

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/managing-notifications">
class="dn-flex">

<a
<span

<span class="dn-icon dn-icon-managing-notifications" data-hires-
status="pending">

Managing notifications


```
        <li class="dn-list-item">
href="/design/human-interface-guidelines/patterns/modality">
class="dn-flex">
        <span class="dn-icon dn-icon-modality"
data-hires-status="pending"></span>
        <span>Modality</span>
        </li>
</a>
</span>
```

```
        <li class="dn-list-item">
href="/design/human-interface-guidelines/patterns/multitasking">
class="dn-flex">
        <span class="dn-icon dn-icon-multitasking" data-hires-
status="pending"></span>
        <span>Multitasking</span>
        </li>
</a>
</span>
```

```
        <li class="dn-list-item">
href="/design/human-interface-guidelines/patterns/offering-help">
class="dn-flex">
        <span class="dn-icon dn-icon-offering-help" data-hires-
status="pending"></span>
        <span>Offering help</span>
        </li>
</a>
</span>
```

```
        <li class="dn-list-item">
href="/design/human-interface-guidelines/patterns/onboarding">
```

```
class="dn-flex">
    <span class="dn-icon dn-icon-onboarding" data-hires-
status="pending"></span>
    <span>Onboarding</span>
</span>
</a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/playing-audio">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-playing-audio" data-hires-
status="pending"></span>
        <span>Playing audio</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/playing-haptics">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-playing-haptics" data-hires-
status="pending"></span>
        <span>Playing haptics</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/patterns/playing-video">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-playing-video" data-hires-
status="pending"></span>
```

Playing video

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/printing">
class="dn-flex">

<a
<span

<span class="dn-icon dn-icon-printing"
data-hires-status="pending">

Printing

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/ratings-and-reviews">
class="dn-flex">

<a
<span

<span class="dn-icon dn-icon-ratings-and-reviews" data-hires-
status="pending">

Ratings and reviews

<li class="dn-list-item">

href="/design/human-interface-guidelines/patterns/searching">
class="dn-flex">

<a
<span

<span class="dn-icon dn-icon-searching" data-hires-
status="pending">

Searching


```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/settings">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-settings"
data-hires-status="pending"></span>
                    <span>Settings</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/undo-and-redo">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-undo-and-redo" data-hires-
status="pending"></span>
                    <span>Undo and redo</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/patterns/workouts">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-workouts"
data-hires-status="pending"></span>
                    <span>Workouts</span>
                </span>
            </a>
        </li>

```

```

    </ul>

```

```

</li>

```

```
<li class="dn-list-item">
<span
class="dn-flex">
  <span class="dn-icon dn-icon-components"></span>
  <span class="dn-list-title">Components</span>
</span>
<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item dn-list-item-link">
<a
href="/design/human-interface-guidelines/components/all-components">
  <span class="dn-flex">
    <span class="dn-icon dn-icon-all-components" data-hires-
status="pending"></span>
    <span>All components</span>
  </span>
</a>
</li>
```

```
<li class="dn-list-item">
<span
class="dn-flex">
  <span class="dn-icon dn-icon-content"
data-hires-status="pending"></span>
  <span class="dn-list-title">Content</span>
</span>
<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/components/content/image-views">
```



```
class="dn-flex">
    <span class="dn-icon dn-icon-image-views"></span>
    <span>Image views</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/content/text-views">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-text-views"></span>
        <span>Text views</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/components/content/web-views">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-web-views"></span>
        <span>Web views</span>
        </span>
    </a>
</li>
```

```
</ul>
```

```
</li>
```

```
<li class="dn-list-item">
    <span
class="dn-flex">
```

```
<span class="dn-icon dn-icon-layout-and-organization" data-hires-  
status="pending"></span>
```

```
<span class="dn-list-title">Layout and organization</span>  
</span>
```

```
<ul class="dn-list-container"  
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item">
```

```
<a  
href="/design/human-interface-guidelines/components/layout-and-organization/  
boxes">
```

```
<span  
class="dn-flex">
```

```
<span class="dn-icon dn-icon-boxes"></span>
```

```
<span>Boxes</span>
```

```
</span>
```

```
</a>
```

```
</li>
```

```
<li class="dn-list-item">
```

```
<a  
href="/design/human-interface-guidelines/components/layout-and-organization/  
collections">
```

```
<span  
class="dn-flex">
```

```
<span class="dn-icon dn-icon-collections"></span>
```

```
<span>Collections</span>
```

```
</span>
```

```
</a>
```

```
</li>
```

```
<li class="dn-list-item">
```

```
<a  
href="/design/human-interface-guidelines/components/layout-and-organization/  
column-views">
```

```
<span  
class="dn-flex">
```

```
<span class="dn-icon dn-icon-column-views"></span>
```

```
<span>Column views</span>
```

```
</span>
```

```
</a>
```


<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/layout-and-organization/
disclosure-controls">

<span
class="dn-flex">

Disclosure controls

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/layout-and-organization/
labels">

<span
class="dn-flex">

Labels

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/layout-and-organization/
lists-and-tables">

<span
class="dn-flex">

Lists and tables

<li class="dn-list-item">

Tab views

<li class="dn-list-item">

class="dn-flex">

<span

Menus and actions

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

<span

class="dn-flex">

Activity views

<li class="dn-list-item">

<span

class="dn-flex">

Buttons

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/menus-and-actions/
context-menus">

<span

class="dn-flex">

Context menus

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/menus-and-actions/dock-
menus">

<span

class="dn-flex">

Dock menus

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/components/menus-and-actions/edit-
menus">

<span

class="dn-flex">

Edit menus

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/menus-and-actions/
menus">

<span

class="dn-flex">

Menus

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/menus-and-actions/pop-
up-buttons">

<span

class="dn-flex">

Pop-up buttons

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/menus-and-actions/pull-
down-buttons">

<span

class="dn-flex">

Pull-down buttons

<li class="dn-list-item">


```
<span class="dn-icon dn-icon-tab-bars"></span>
<span>Tab bars</span>
</li>
</a>
</span>
</li>
<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/components/navigation-and-search/
token-fields">
<span
class="dn-flex">
<span class="dn-icon dn-icon-token-fields"></span>
<span>Token fields</span>
</span>
</a>
</li>
</ul>
</li>
```

```
<li class="dn-list-item">
<span
class="dn-flex">
<span class="dn-icon dn-icon-presentation" data-hires-
status="pending"></span>
<span class="dn-list-title">Presentation</span>
</span>
<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/components/presentation/action-
sheets">
<span
class="dn-flex">
```


Action sheets

<li class="dn-list-item">

<span

class="dn-flex">

Alerts

<li class="dn-list-item">

<span

class="dn-flex">

Page controls

<li class="dn-list-item">

<span

class="dn-flex">

Panels

Windows

<li class="dn-list-item">

class="dn-flex">

<span

Selection and input

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

<a

<span

class="dn-flex">

Color wells

<li class="dn-list-item">

<a

<span

class="dn-flex">

Combo boxes

<li class="dn-list-item">

<span

class="dn-flex">

Digit entry views

<li class="dn-list-item">

<span

class="dn-flex">

Image wells

<li class="dn-list-item">

<span

class="dn-flex">

Onscreen keyboards

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/selection-and-input/
pickers">

<span

class="dn-flex">

Pickers

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/selection-and-input/
segmented-controls">

<span

class="dn-flex">

Segmented controls

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/components/selection-and-input/
sliders">

<span

class="dn-flex">

Sliders

<li class="dn-list-item">

```

                                <a
href="/design/human-interface-guidelines/components/selection-and-input/
steppers">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-steppers"></span>
                                <span>Steppers</span>
                                </span>
                                </a>
                                </li>

```

```

                                <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/components/selection-and-input/text-
fields">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-text-fields"></span>
                                <span>Text fields</span>
                                </span>
                                </a>
                                </li>

```

```

                                <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/components/selection-and-input/
toggles">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-toggles"></span>
                                <span>Toggles</span>
                                </span>
                                </a>
                                </li>

```

```

                                </ul>

```

```

                                </li>

```



```

    <li class="dn-list-item">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-status"
data-hires-status="pending"></span>
            <span class="dn-list-title">Status</span>
        </span>

```

```

    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```

```

    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/components/status/activity-rings">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-activity-rings"></span>
                <span>Activity rings</span>
            </span>
        </a>
    </li>

```

```

    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/components/status/level-indicators">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-level-indicators"></span>
                <span>Level indicators</span>
            </span>
        </a>
    </li>

```

```

    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/components/status/progress-
indicators">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-progress-indicators"></span>

```

```

    <span>Progress indicators</span>
                                </span>
                                </a>
                                </li>
                                </ul>
                                </li>

```

```

    <li class="dn-list-item">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-system-experiences" data-hires-
status="pending"></span>
                                <span class="dn-list-title">System experiences</span>
                                </span>
                                <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/components/system-experiences/
complications">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-complications"></span>
                                <span>Complications</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/components/system-experiences/
home-screen-quick-actions">
                                <span
class="dn-flex">
                                <span class="dn-icon dn-icon-home-screen-quick-actions"></span>

```

Home Screen quick actions

<li class="dn-list-item">

<span
class="dn-flex">

The menu bar

<li class="dn-list-item">

<span
class="dn-flex">

Notifications

<li class="dn-list-item">

<span
class="dn-flex">

Status bars


```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/system-experiences/top-shelf">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-top-shelf"></span>
                    <span>Top Shelf</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/system-experiences/watch-faces">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-watch-faces"></span>
                    <span>Watch faces</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/components/system-experiences/widgets">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-widgets"></span>
                    <span>Widgets</span>
                </a>
            </li>

```

```

    </ul>

```

```

</li>

```



```
<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-inputs"></span>
    <span class="dn-list-title">Inputs</span>
  </span>
  <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/inputs/overview">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-overview"
data-hires-status="pending"></span>
          <span>Overview</span>
        </span>
      </a>
    </li>
```

```
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/inputs/apple-pencil-and-scribble">
        <span
class="dn-flex">
          <span class="dn-icon dn-icon-apple-pencil-and-scribble" data-hires-
status="pending"></span>
          <span>Apple Pencil and Scribble</span>
        </span>
      </a>
    </li>
```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/inputs/digital-crown">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-digital-crown" data-hires-
status="pending"></span>
                    <span>Digital Crown</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/inputs/focus-and-selection">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-focus-and-selection" data-hires-
status="pending"></span>
                    <span>Focus and selection</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/inputs/game-controllers">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-game-controllers" data-hires-
status="pending"></span>
                    <span>Game controllers</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/inputs/gyro-and-accelerometer">
                <span
class="dn-flex">

```



```
</a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/inputs/spatial-interactions">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-spatial-interactions" data-hires-  
status="pending"></span>  
      <span>Spatial interactions</span>  
    </span>  
  </a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/inputs/touch-bar">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-touch-bar" data-hires-  
status="pending"></span>  
      <span>Touch Bar</span>  
    </span>  
  </a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/inputs/touchscreen-gestures">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-touchscreen-gestures" data-hires-  
status="pending"></span>  
      <span>Touchscreen gestures</span>  
    </span>  
  </a>  
</li>
```

```
</ul>
```



```
<li class="dn-list-item">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-technologies"></span>
        <span class="dn-list-title">Technologies</span>
    </span>
    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item dn-list-item-link">
    <a
href="/design/human-interface-guidelines/technologies/all-technologies">
        <span class="dn-flex">
            <span class="dn-icon dn-icon-all-technologies" data-hires-
status="pending"></span>
            <span>All technologies</span>
        </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-airplay"
data-hires-status="pending"></span>
        <span class="dn-list-title">AirPlay</span>
    </span>
    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/airplay/introduction">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-introduction"></span>
                    <span>Introduction</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/airplay/icons">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-icons"
data-hires-status="pending"></span>
                    <span>Icons</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/airplay/editorial">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-editorial"></span>
                    <span>Editorial</span>
                </a>
            </li>

```

```

    </ul>

```

```

</li>

```

```
<li class="dn-list-item dn-list-item-link">
  <a
href="/design/human-interface-guidelines/technologies/always-on">
    <span class="dn-flex">
      <span class="dn-icon dn-icon-always-on" data-hires-
status="pending"></span>
      <span>Always On</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-app-clips"
data-hires-status="pending"></span>
    <span class="dn-list-title">App Clips</span>
  </span>
```

```
    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
      <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/technologies/app-clips/introduction">
          <span
class="dn-flex">
            <span class="dn-icon dn-icon-introduction"></span>
            <span>Introduction</span>
          </span>
        </a>
      </li>
```

```
    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/technologies/app-clips/experience">
```



```

</li>
</a>
</li>

<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/technologies/app-clips/legal-
requirements">
<span
class="dn-flex">
<span class="dn-icon dn-icon-legal-requirements"></span>
<span>Legal requirements</span>
</span>
</a>
</li>

</ul>

</li>

<li class="dn-list-item">
<span
class="dn-flex">
<span class="dn-icon dn-icon-apple-pay" data-hires-
status="pending"></span>
<span class="dn-list-title">Apple Pay</span>
</span>
<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
<li class="dn-list-item">
<a
href="/design/human-interface-guidelines/technologies/apple-pay/introduction">
<span
class="dn-flex">
<span class="dn-icon dn-icon-introduction"></span>
<span>Introduction</span>
</span>
</a>
</li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/apple-pay/offering-apple-pay">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-offering-apple-pay"></span>
                <span>Offering Apple Pay</span>
            </span>
        </a>
    </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/apple-pay/checkout-and-payment">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-checkout-and-payment"></span>
                <span>Checkout and payment</span>
            </span>
        </a>
    </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/apple-pay/handling-errors">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-handling-errors"></span>
                <span>Error handling</span>
            </span>
        </a>
    </li>

```

```

        <li class="dn-list-item">

```

```

                                <a
href="/design/human-interface-guidelines/technologies/apple-pay/subscriptions-
and-donations">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-subscriptions-and-donations"></span>
    <span>Subscriptions and donations</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/apple-pay/buttons-and-
marks">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-buttons-and-marks"></span>
    <span>Buttons and marks</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/apple-pay/editorial-
guidelines">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-editorial-guidelines"></span>
    <span>Editorial</span>
                                </span>
                                </a>
                                </li>

```

```

</ul>

```

```

</li>

```

```
<li class="dn-list-item dn-list-item-link">
    <a
href="/design/human-interface-guidelines/technologies/augmented-reality">
    <span class="dn-flex">
        <span class="dn-icon dn-icon-augmented-reality" data-hires-
status="pending"></span>
        <span>Augmented reality</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-carekit"
data-hires-status="pending"></span>
        <span class="dn-list-title">CareKit</span>
    </span>
```

```
<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/carekit/introduction">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-introduction"></span>
        <span>Introduction</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
```



```

                                <a
href="/design/human-interface-guidelines/technologies/carekit/data-and-
privacy">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-data-and-privacy"></span>
    <span>Data and privacy</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/carekit/views">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-views"></span>
    <span>Views</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/carekit/user-
experience">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-user-experience"></span>
    <span>User experience</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/carekit/symbols-and-
branding">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-symbols-and-branding"></span>

```

```
<span>Symbols and branding</span>
</a>
</li>
</ul>
</li>

<li class="dn-list-item">
  class="dn-flex">
    <span class="dn-icon dn-icon-carplay"
      data-hires-status="pending"></span>
    <span class="dn-list-title">CarPlay</span>
  </span>
  <ul class="dn-list-container"
    style="transition: max-height 0.2s ease-in-out 0s;">
    <li class="dn-list-item">
      <a
        href="/design/human-interface-guidelines/technologies/carplay/introduction">
        <span
          class="dn-flex">
            <span class="dn-icon dn-icon-introduction"></span>
            <span>Introduction</span>
          </span>
      </a>
    </li>
    <li class="dn-list-item">
      <a
        href="/design/human-interface-guidelines/technologies/carplay/architecture">
        <span
          class="dn-flex">
            <span class="dn-icon dn-icon-architecture"></span>
            <span>Architecture</span>
          </span>
      </a>
    </li>
  </ul>
</li>
</ul>
```

```
</a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/technologies/carplay/interaction">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-interaction"></span>  
      <span>Interaction</span>  
    </span>  
  </a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/technologies/carplay/visual-design">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-visual-design"></span>  
      <span>Visual design</span>  
    </span>  
  </a>  
</li>
```

```
<li class="dn-list-item">  
  <a  
href="/design/human-interface-guidelines/technologies/carplay/icons-and-  
images">  
    <span  
class="dn-flex">  
      <span class="dn-icon dn-icon-icons-and-images"></span>  
      <span>Icons and images</span>  
    </span>  
  </a>  
</li>
```

```
<li class="dn-list-item">
```



```
<span class="dn-icon dn-icon-leaderboards"></span>

<span>Leaderboards</span>

</li>
</a>
</span>

<li class="dn-list-item">
  <a
    href="/design/human-interface-guidelines/technologies/game-center/
    multiplayer">
    <span
      class="dn-flex">
        <span class="dn-icon dn-icon-multiplayer"></span>
        <span>Multiplayer</span>
      </span>
    </a>
  </li>

  <li class="dn-list-item">
    <a
      href="/design/human-interface-guidelines/technologies/game-center/custom-
      dashboard-links">
        <span
          class="dn-flex">
            <span class="dn-icon dn-icon-custom-dashboard-links"></span>
            <span>Custom dashboard links</span>
          </span>
        </a>
      </li>

    </ul>

  </li>

  <li class="dn-list-item dn-list-item-link">
    <a
      href="/design/human-interface-guidelines/technologies/healthkit">
```

```
<span class="dn-flex">
  <span class="dn-icon dn-icon-healthkit"
data-hires-status="pending"></span>
  <span>HealthKit</span>
</span>
</li> </a>
```

```
<li class="dn-list-item">
  <span
class="dn-flex">
    <span class="dn-icon dn-icon-homekit"
data-hires-status="pending"></span>
    <span class="dn-list-title">HomeKit</span>
  </span>
```

```
<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/technologies/homekit/introduction">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-introduction"></span>
      <span>Introduction</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/technologies/homekit/terminology-
and-layout">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-terminology-and-layout"></span>
```

Terminology and layout

<li class="dn-list-item">

<span
class="dn-flex">

Setup

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/homekit/siri-
interactions">
<span
class="dn-flex">

Siri interactions

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/homekit/custom-
functionality">
<span
class="dn-flex">

Custom functionality


```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/homekit/icons">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-icons"
data-hires-status="pending"></span>
                    <span>Icons</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/homekit/editorial">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-editorial"></span>
                    <span>Editorial</span>
                </span>
            </a>
        </li>

```

```

    </ul>

```

```

    </li>

```

```

    <li class="dn-list-item dn-list-item-link">
        <a
href="/design/human-interface-guidelines/technologies/icloud">
            <span class="dn-flex">
                <span class="dn-icon dn-icon-icloud"
data-hires-status="pending"></span>
                <span>iCloud</span>
            </span>
        </a>
    </li>

```

```

        <li class="dn-list-item">
            <span
class="dn-flex">
                <span class="dn-icon dn-icon-in-app-purchase" data-hires-
status="pending"></span>
                <span class="dn-list-title">In-app purchase</span>
            </span>
            <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
                <li class="dn-list-item">
                    <a
href="/design/human-interface-guidelines/technologies/in-app-purchase/
introduction">
                        <span
class="dn-flex">
                            <span class="dn-icon dn-icon-introduction"></span>
                            <span>Introduction</span>
                        </span>
                    </a>
                </li>
                <li class="dn-list-item">
                    <a
href="/design/human-interface-guidelines/technologies/in-app-purchase/auto-
renewable-subscriptions">
                        <span
class="dn-flex">
                            <span class="dn-icon dn-icon-auto-renewable-subscriptions"></span>
                            <span>Auto-renewable subscriptions</span>
                        </span>
                    </a>
                </li>
            </ul>
        </li>

```

```
<li class="dn-list-item dn-list-item-link">
    <a
href="/design/human-interface-guidelines/technologies/live-photos">
    <span class="dn-flex">
        <span class="dn-icon dn-icon-live-photos" data-hires-
status="pending"></span>
        <span>Live Photos</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-mac-catalyst" data-hires-
status="pending"></span>
        <span class="dn-list-title">Mac Catalyst</span>
    </span>
    <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
    <li class="dn-list-item">
        <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/
introduction">
        <span
class="dn-flex">
            <span class="dn-icon dn-icon-introduction"></span>
            <span>Introduction</span>
        </span>
    </a>
    </li>
```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/app-
structure">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-app-structure"></span>
                    <span>App structure</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/user-
interaction">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-user-interaction"></span>
                    <span>User interaction</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/visual-
design">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-visual-design"></span>
                    <span>Visual design</span>
                </span>
            </a>
        </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/mac-catalyst/mac-
idiom">

```

```
class="dn-flex">
    <span class="dn-icon dn-icon-mac-idiom"></span>
    <span>Mac idiom</span>
    </a>
</li>
</ul>
```

```
<li class="dn-list-item">
    class="dn-flex">
        <span class="dn-icon dn-icon-machine-learning" data-hires-
        status="pending"></span>
        <span class="dn-list-title">Machine learning</span>
        <ul class="dn-list-container"
        style="transition: max-height 0.2s ease-in-out 0s;">
```

```
        <li class="dn-list-item">
            <a
            href="/design/human-interface-guidelines/technologies/machine-learning/
            introduction">
                <span>
                    class="dn-flex">
                        <span class="dn-icon dn-icon-introduction"></span>
                        <span>Introduction</span>
                    </span>
                </a>
            </li>
```

```
        <li class="dn-list-item">
            <a
            href="/design/human-interface-guidelines/technologies/machine-learning/roles">
                <span>
                    class="dn-flex">
```


Machine learning roles

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/technologies/machine-learning/
explicit-feedback">

<span

class="dn-flex">

Explicit feedback

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/technologies/machine-learning/
implicit-feedback">

<span

class="dn-flex">

Implicit feedback

<li class="dn-list-item">

<a

href="/design/human-interface-guidelines/technologies/machine-learning/
calibration">

<span

class="dn-flex">

Calibration


```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/technologies/machine-learning/
corrections">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-corrections"></span>
      <span>Corrections</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/technologies/machine-learning/
mistakes">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-mistakes"></span>
      <span>Mistakes</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/technologies/machine-learning/
multiple-options">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-multiple-options"></span>
      <span>Multiple options</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
```

```

                                <a
href="/design/human-interface-guidelines/technologies/machine-learning/
confidence">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-confidence"></span>
    <span>Confidence</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/machine-learning/
attribution">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-attribution"></span>
    <span>Attribution</span>
                                </span>
                                </a>
                                </li>

```

```

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/machine-learning/
limitations">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-limitations"></span>
    <span>Limitations</span>
                                </span>
                                </a>
                                </li>

```

```

</ul>

```

```

</li>

```



```
<li class="dn-list-item">
<span
class="dn-flex">
  <span class="dn-icon dn-icon-maps"
data-hires-status="pending"></span>
  <span class="dn-list-title">Maps</span>
</span>
```

```
<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/technologies/maps/introduction">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-introduction"></span>
      <span>Introduction</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/technologies/maps/apple-watch-
maps">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-apple-watch-maps"></span>
      <span>Apple Watch maps</span>
    </span>
  </a>
</li>
```

```
<li class="dn-list-item">
  <a
href="/design/human-interface-guidelines/technologies/maps/indoor-maps">
    <span
class="dn-flex">
      <span class="dn-icon dn-icon-indoor-maps"></span>
```

```

        <span>Indoor maps</span>
                                </span>
                        </a>
                </li>

        </ul>

                                </li>

<li class="dn-list-item">
                                <span
class="dn-flex">
        <span class="dn-icon dn-icon-messages-for-business" data-hires-
status="pending"></span>

        <span class="dn-list-title">Messages for Business</span>
                                </span>

                                <ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

                <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
introduction">
                                <span
class="dn-flex">
        <span class="dn-icon dn-icon-introduction"></span>

        <span>Introduction</span>
                                </span>
                                </a>
                </li>

                <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
branding">
                                <span
class="dn-flex">
        <span class="dn-icon dn-icon-branding"
data-hires-status="pending"></span>

```

Branding

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/messages-for-business/
buttons">

<span
class="dn-flex">

Buttons

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/messages-for-business/
color">

<span
class="dn-flex">

<span class="dn-icon dn-icon-color"
data-hires-status="pending">

Color

<li class="dn-list-item">

<a
href="/design/human-interface-guidelines/technologies/messages-for-business/
dark-mode">

<span
class="dn-flex">

<span class="dn-icon dn-icon-dark-mode" data-hires-
status="pending">

Dark Mode


```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
logo">
      <span
class="dn-flex">
        <span class="dn-icon dn-icon-logo"></span>
        <span>Logo</span>
      </span>
    </a>
  </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
message-bubble-content">
      <span
class="dn-flex">
        <span class="dn-icon dn-icon-message-bubble-content"></span>
        <span>Message bubble content</span>
      </span>
    </a>
  </li>

```

```

    <li class="dn-list-item">
      <a
href="/design/human-interface-guidelines/technologies/messages-for-business/
screenshots">
      <span
class="dn-flex">
        <span class="dn-icon dn-icon-screenshots"></span>
        <span>Screenshots</span>
      </span>
    </a>
  </li>

```



```
<li class="dn-list-item dn-list-item-link">
    <a
href="/design/human-interface-guidelines/technologies/nfc">
    <span class="dn-flex">
    <span class="dn-icon dn-icon-nfc" data-hires-status="pending"></span>
    <span>NFC</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item dn-list-item-link">
    <a
href="/design/human-interface-guidelines/technologies/photo-editing">
    <span class="dn-flex">
    <span class="dn-icon dn-icon-photo-editing" data-hires-
status="pending"></span>
    <span>Photo editing</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item dn-list-item-link">
    <a
href="/design/human-interface-guidelines/technologies/researchkit">
    <span class="dn-flex">
    <span class="dn-icon dn-icon-researchkit" data-hires-
status="pending"></span>
```

ResearchKit

<li class="dn-list-item dn-list-item-link">

href="/design/human-interface-guidelines/technologies/shareplay"> <a>

SharePlay

<li class="dn-list-item dn-list-item-link">

href="/design/human-interface-guidelines/technologies/shazamkit"> <a>

ShazamKit

<li class="dn-list-item">

class="dn-flex">

Sign in with Apple

<ul class="dn-list-container" style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">

Introduction

<li class="dn-list-item">

Data management

<li class="dn-list-item">

Buttons

<li class="dn-list-item">
class="dn-flex">

Siri

<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">

<li class="dn-list-item">
href="/design/human-interface-guidelines/technologies/siri/introduction">
class="dn-flex">

Introduction

<li class="dn-list-item">
href="/design/human-interface-guidelines/technologies/siri/system-intents">
class="dn-flex">

System intents


```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/siri/custom-intents">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-custom-intents"></span>
                    <span>Custom intents</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/siri/shortcuts-and-
suggestions">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-shortcuts-and-suggestions"></span>
                    <span>Shortcuts and suggestions</span>
                </a>
            </li>

```

```

        <li class="dn-list-item">
            <a
href="/design/human-interface-guidelines/technologies/siri/editorial-guidelines">
                <span
class="dn-flex">
                    <span class="dn-icon dn-icon-editorial-guidelines"></span>
                    <span>Editorial</span>
                </a>
            </li>

```

```

    </ul>

```

```

</li>

```

```
<li class="dn-list-item dn-list-item-link">
    <a
href="/design/human-interface-guidelines/technologies/tap-to-pay-on-iphone">
    <span class="dn-flex">
        <span class="dn-icon dn-icon-tap-to-pay-on-iphone" data-hires-
status="pending"></span>
        <span>Tap to Pay on iPhone</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-wallet"
data-hires-status="pending"></span>
        <span class="dn-list-title">Wallet</span>
    </span>
```

```
<ul class="dn-list-container"
style="transition: max-height 0.2s ease-in-out 0s;">
```

```
<li class="dn-list-item">
    <a
href="/design/human-interface-guidelines/technologies/wallet/introduction">
    <span
class="dn-flex">
        <span class="dn-icon dn-icon-introduction"></span>
        <span>Introduction</span>
    </span>
    </a>
</li>
```

```
<li class="dn-list-item">
```

```

                                <a
href="/design/human-interface-guidelines/technologies/wallet/designing-
passes">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-designing-passes"></span>
    <span>Designing passes</span>
                                </span>
                                </a>
                                </li>

    <li class="dn-list-item">
                                <a
href="/design/human-interface-guidelines/technologies/wallet/designing-order-
tracking">
                                <span
class="dn-flex">
    <span class="dn-icon dn-icon-designing-order-tracking"></span>
    <span>Designing order tracking</span>
                                </span>
                                </a>
                                </li>

</ul>

                                </li>

</ul>

                                </li>

</ul>

                                </li>

</ul>

                                </li>

                                </nav>
                                </div>

                                <!-- Main content -->
                                <div class="column hig-content no-padding-top"
data-hires="true" id="hig-content">
```

```

<link rel="stylesheet"
href="/design/human-interface-guidelines/styles/gallery.css" type="text/css">

<h1>Platforms<div class="column hig-right-nav" id="hig-right-nav">
    <div class="hig-right-nav-content" id="hig-right-nav-
content">
        <ul
class="Sidenav_container" style="top: 80px; display: none;"><div
class="SidenavLine_line helpers-module_transition" style="transform:
translateY(0px);"></div> </ul>
<script src="/assets/scripts/sidenav.built.js?41172203193"></script>
        </div>
    </div></h1>
<p class="nosort">Create an app or game that feels at home on every platform
you support.</p>

<div class="grid-view" id="gallery">
    <div class="category category-container">
        <div class="category-content category-items">

            <a class="topic
topic-item designing-for-ios"
href="/design/human-interface-guidelines/platforms//designing-for-ios">
                <div class="topic-image-
container">

                </div>

                <div class="topic-text">
                    <h4 class="topic-
title">Designing for iOS</h4>

                    <p class="topic-
description">People depend on their iPhone to help them stay connected, play
games, view media, accomplish tasks, and track personal data in any location
and while on the go.</p>

                    <p style="display:none"
class="topic-data">

                        ios

                        foo

                        bar

                    </p>

                </div>
            </a>

```

```

<a class="topic topic-item designing-for-ipados"
href="/design/human-interface-guidelines/platforms//designing-for-ipados">
    <div class="topic-image-
container">

    </div>

    <div class="topic-text">
        <h4 class="topic-
title">Designing for iPadOS</h4>

        <p class="topic-
description">People value the power, mobility, and flexibility of iPad as they
enjoy media, play games, perform detailed productivity tasks, and bring their
creations to life.</p>

        <p style="display:none"
class="topic-data">

            ipados

            foo

            bar

    </p>

    </div>
</a>

```

```

<a class="topic topic-item designing-for-macos"
href="/design/human-interface-guidelines/platforms//designing-for-macos">
    <div class="topic-image-
container">

    </div>

    <div class="topic-text">
        <h4 class="topic-
title">Designing for macOS</h4>

        <p class="topic-
description">People rely on the power, spaciousness, and flexibility of a Mac as
they perform in-depth productivity tasks, view media or content, and play
games, often using several apps at once.</p>

        <p style="display:none"
class="topic-data">

```

macos

foo

bar

</p>

</div>

<div class="topic-image-container">

</div>

<div class="topic-text">
<h4 class="topic-title">Designing for tvOS</h4>

<p class="topic-description">People enjoy the vibrant content, immersive experiences, and streamlined interactions that tvOS delivers in media and games, as well as in fitness, education, and home utility apps.</p>

<p style="display:none" class="topic-data">

tvos

foo

bar

</p>

</div>

<div class="topic-image-container">

</div>

```

<div class="topic-text">
  <h4 class="topic-
title">Designing for watchOS</h4>
  <p class="topic-
description">When people glance at their Apple Watch, they know they can
access essential information and perform simple, timely tasks whether they're
stationary or in motion.</p>
  <p style="display:none"
class="topic-data">
    watchos
    foo
    bar
  </p>
</div>
</a>
</div>
</div>
</div>
<!-- Resources -->
</div>
</div>
</div>
</section>
</main>

<link rel="stylesheet" href="/assets/styles/footer.dist.css?
41172203193">
<footer id="footer" class="footer" role="contentinfo" aria-labelledby="footer-
label">
  <div class="footer-content">
    <h2 class="footer-label" id="footer-label">Developer Footer</h2>
    <developer-breadcrumbs style="display: block;">

    <nav class="footer-breadcrumbs" aria-
label="Breadcrumbs"><a href="https://www.apple.com/" class="home footer-
breadcrumbs-home"><span class="footer-breadcrumbs-home-icon" aria-
hidden="true" data-hires-status="pending"></span><span class="footer-
breadcrumbs-home-label">Apple</span></a><div class="footer-breadcrumbs-

```

```

path"><ol class="footer-breadcrumbs-list"><li class="footer-breadcrumbs-
item"><a href="/">Developer</a></li><li class="footer-breadcrumbs-
item"><a href="/design/">Design</a></li><li class="footer-breadcrumbs-
item"><a href="/design/human-interface-guidelines/">Human Interface
Guidelines</a></li><li
class="footer-breadcrumbs-item">Platforms</li></ol></div></nav></develop
er-breadcrumbs>
    <nav class="footer-directory" aria-label="Apple Developer Directory"
role="navigation">
        <!--googleoff: all-->
        <div class="footer-directory-column">
            <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-platform">
            <div class="footer-directory-column-section">
                <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-platform">
                    <h3 class="footer-directory-column-section-
title">Platforms</h3>
                    </label>
                    <a href="#footer-directory-column-section-state-platform"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
                    <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
                    <ul class="footer-directory-column-section-list">
                        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/ios/">iOS</a></li>
                        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/ipados/">iPadOS</a></li>
                        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/macos/">macOS</a></li>
                        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/tvos/">tvOS</a></li>
                        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/watchos/">watchOS</a></li>
                    </ul>
                </div>

                <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-tools">
                <div class="footer-directory-column-section">
                    <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-tools">
                        <h3 class="footer-directory-column-section-
title">Tools</h3>
                        </label>
                        <a href="#footer-directory-column-section-state-tools"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>

```



```

        <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/swift/">Swift</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/swiftui/">SwiftUI</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/swift-playgrounds/">Swift
Playgrounds</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/testflight/">TestFlight</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/xcode/">Xcode</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/xcode-cloud/">Xcode
Cloud</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/sf-symbols/">SF
Symbols</a></li>
        </ul>
    </div>
</div>

<div class="footer-directory-column">
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-topics">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-topics">
            <h3 class="footer-directory-column-section-
title">Topics & Technologies</h3>
        </label>
        <a href="#footer-directory-column-section-state-topics"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
        <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/accessibility/">Accessibility</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/accessories/">Accessories</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-extensions/">App
Extensions</a></li>

```

```

        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-store/">App
Store</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/audio/">Audio &
Video</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/augmented-
reality/">Augmented Reality</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/business/">Business</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/design/">Design</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/distribute/">Distribution</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/education/">Education</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/fonts/">Fonts</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/games/">Games</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/health-fitness/">Health
& Fitness</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/in-app-purchase/">In-App
Purchase</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/localization/">Localization</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/maps/">Maps &
Location</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/machine-learning/">Machine
Learning</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/security/">Security</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/safari/">Safari &
Web</a></li>
    </ul>
</div>
</div>
</div>
<div class="footer-directory-column">
    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-resources">
    <div class="footer-directory-column-section">

```

```
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-resources">
            <h3 class="footer-directory-column-section-
title">Resources</h3>
        </label>
        <a href="#footer-directory-column-section-state-resources"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
        <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/documentation/">Documentation</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/learn/curriculum/">Curriculum</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/download/">Downloads</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="https://developer.apple.com/forums/">Forums</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/videos/">Videos</a></li>
        </ul>
    </div>
```

```
        <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-support">
        <div class="footer-directory-column-section">
            <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-support">
                <h3 class="footer-directory-column-section-
title">Support</h3>
            </label>
            <a href="#footer-directory-column-section-state-support"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
            <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
            <ul class="footer-directory-column-section-list">
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/support/articles/">Support
Articles</a></li>
                <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/contact/">Contact
Us</a></li>
```

[Bug Reporting](/bug-reporting/)

[System Status](/system-status/)

☐

Account

[Open Menu](#footer-directory-column-section-state-account)

[Close Menu](#)

- [Apple Developer](/account/)

- [App Store Connect](https://appstoreconnect.apple.com/)
- [Certificates, IDs, & Profiles](/account/ios/certificate/)
- [Feedback Assistant](https://feedbackassistant.apple.com/)

☐

Programs

[Open Menu](#footer-directory-column-section-state-programs)

```

        <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/">Apple Developer
Program</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/enterprise/">Apple
Developer Enterprise Program</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-store/small-business-
program/">App Store Small Business Program</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="https://mfi.apple.com/">MFi
Program</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/news-
partner/">News Partner Program</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/video-
partner/">Video Partner Program</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/security-bounty/">Security
Bounty Program</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/programs/security-research-
device/">Security Research Device Program</a></li>
        </ul>
    </div>

    <input class="footer-directory-column-section-state"
type="checkbox" id="footer-directory-column-section-state-events">
    <div class="footer-directory-column-section">
        <label class="footer-directory-column-section-label"
for="footer-directory-column-section-state-events">
            <h3 class="footer-directory-column-section-
title">Events</h3>
        </label>
        <a href="#footer-directory-column-section-state-events"
class="footer-directory-column-section-anchor footer-directory-column-section-
anchor-open"> <span class="footer-directory-column-section-anchor-
label">Open Menu</span> </a>
        <a href="#" class="footer-directory-column-section-anchor
footer-directory-column-section-anchor-close"> <span class="footer-directory-
column-section-anchor-label">Close Menu</span> </a>
        <ul class="footer-directory-column-section-list">
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/accelerator/">App
Accelerators</a></li>
            <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/app-store/app-store-
awards/">App Store Awards</a></li>

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        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/design/awards/">Apple
Design Awards</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link"
href="/learn/experts/#academies">Apple Developer Academies</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/entrepreneur-
camp/">Entrepreneur Camp</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/tech-talks/">Tech
Talks</a></li>
        <li class="footer-directory-column-section-item"><a
class="footer-directory-column-section-link" href="/wwdc/">WWDC</a></li>
    </ul>
</div>
</div>
<!--googleon: all-->
</nav>
<section class="footer-mini" vocab="http://schema.org/"
typeof="Organization">
    <div class="footer-mini-news">
        <div class="copy">
            To view the latest developer news, visit <a
href="/news/">News and Updates</a>.
        </div>
        <div class="content">
            <div class="color-scheme-toggle" role="radiogroup"
tabindex="0" aria-label="Select a color scheme preference">

                <label data-color-scheme-option="light">

                    <input type="radio" value="light"
autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">

                    <div class="text">Light</div>

                </label>

                <label data-color-scheme-option="dark">

                    <input type="radio" value="dark"
autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">

                    <div class="text">Dark</div>

                </label>

                <label data-color-scheme-option="auto">

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        <input type="radio" value="auto"
autocomplete="off"
onchange="window.setPreferredColorScheme(event.target.value)">

        <div class="text">Auto</div>

    </label>

</div>
<script async="" src="/assets/scripts/color-scheme-
toggle.js"></script>
</div>
</div>
<link rel="stylesheet" href="/assets/styles/language-dropdown.css?
41172203193">
<div class="language-dropdown dropdown-container hidden">
    <select class="dropdown" aria-label="Language
Dropdown"></select>
    <span class="dropdown-icon icon icon-chevron-down" aria-
hidden="true"></span>
</div>
<script async="" src="/assets/scripts/lib/jquery/jquery.language-
dropdown.js?41172203193"></script>
<div class="footer-mini-legal">
    <div class="footer-mini-legal-copyright">Copyright © 2022 <a
href="https://www.apple.com">Apple Inc.</a> All rights reserved.</div>
    <div class="footer-mini-legal-links">
        <a class="footer-mini-legal-link"
href="https://www.apple.com/legal/internet-services/terms/site.html">Terms of
Use</a>
        <a class="footer-mini-legal-link"
href="https://www.apple.com/legal/privacy/en-ww/">Privacy Policy</a>
        <a class="footer-mini-legal-link"
href="/support/terms/">Agreements and Guidelines</a>
    </div>
</div>
</section>
</div>
</footer>

</body></html>

```